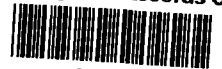


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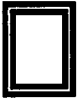
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March 17, 2003

Mr. Steven J. Faryan
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Clayton Project 65263.01-013

RE: The Lockformer Company
711 West Ogden Avenue
Lisle, Illinois 60532

Dear Mr. Faryan:

Enclosed please find six copies of the revised Volume III, Lockformer Work Plan dated February 28, 2003. The Work Plan is the result of numerous iterations of comments and responses involving Lockformer, the U.S. Environmental Protection Agency, the Illinois Environmental Protection Agency, the Illinois Attorney General's Office, and their contractors. The most recent comments pertaining to Volume III of the Work Plan were included in an August 2, 2002 letter issued by Weston Solutions Inc. on behalf of the U.S. Environmental Protection Agency in response to redline and strikeout edits that were conducted during the final stages of the Work Plan development. These comments and the responses to them are provided here.

We have made every attempt to make all corrections and additions per the comments and edits provided to us during the Work Plan discussions. If any portion of the Work Plan appears to be in error, or if you feel any portion of the work plan misrepresents the final discussions and/or comments undertaken regarding the Work Plan, we appreciate notice at your earliest possible convenience.

Sincerely,

A handwritten signature in black ink, appearing to read "William S. Elwell", written in a cursive style.

William S. Elwell, P.G.
Senior Project Manager
Environmental Services

Enclosure: Lockformer Work Plan, Volume III, February 28, 2003

15-65263ca209/WSE

Comment Responses

The following information consists of the comments (*italics*) pertaining to Volume III of the Lockformer Work Plan that were included in an August 2, 2002 letter issued by Weston Solutions Inc. of behalf of the U.S. Environmental Protection Agency. The responses to those comments are presented in bold text.

QAPP COMMENTS (Previously submitted)

1. *Table 17 – Summary of Investigation Sampling and Analyses to Be Performed:*

The number of MS/MSD samples is incorrect throughout the table. The frequency for an MS/MSD sample is 1 per 20 samples. This includes investigative and QC samples. Therefore, for the former vapor degreaser area, there should be 2 MS/MSD samples based on a total of 28 samples (24 investigative and 4 QC samples). The remaining entries also need to be modified. The ratio of equipment rinse blank samples is also 1 per 20 samples. This frequency also needs to be adjusted throughout the table. It is believed that misinformation was provided regarding field blank duplicate samples. Field blank duplicate samples are not required QC samples. However, if the project wishes to include these samples that is not an issue. Finally, this table is missing information pertaining to the air TO-15 samples. Air information needs to be incorporated into this and all other appropriate tables.

RESPONSE: The QC sampling numbers in Table 17 have been revised as requested. Field blank duplicates will not be collected and have been excluded from the table.

The air sampling program and associated quality assurance measures have been removed from body of this QAPP and restructured as an amendment presented in Section 7.0 of the Technical Memorandum – Soil Remediation Design dated October 31, 2002.

2. *Table 18 – Sample Holding Times, Containers, Preservatives, and Volume Requirements:*

The soil and water VOC samples are missing the required 4 ± 2 degrees Celsius under the preservative requirements.

RESPONSE: The information has been added to Table 18.

3. *Section 1.5 Field Sampling Plan:*

This section of the report completely ignores the TO-15 air samples. The sampling procedures, frequencies, etc. need to be incorporated into the QAPP for review.

COMMENT RESPONSES

RESPONSE: The air sampling program and associated quality assurance measures have been removed from body of this QAPP and restructured as an amendment presented in Section 7.0 of the Technical Memorandum – Soil Remediation Design dated October 31, 2002.

4. *Section 5.1:*

Information needs to be included regarding air samples.

RESPONSE: Same as #3.

5. *Response to Comment 127 of May 2002 letter:*

Field blank duplicates are not required. It is at the discretion of the PRP/Clayton if field blank duplicate samples will be collected.

RESPONSE: Field blank duplicates will not be collected and have been excluded from the QAPP.

6. *Response to Comment 132 of May 2002 Letter:*

A full QC package may not be required. However, even a level two data package will include method blank, surrogate, matrix spike, and laboratory control sample information at a minimum. These items may be noted in a laboratory narrative or indicated as outside the quality control limits on some of the data forms. However, the above information still needs to be reviewed by a competent non-laboratory person and appropriate data qualifiers applied. In addition, the laboratory is not supposed to know which samples are trip blanks, rinsate/equipment blanks, or field duplicate samples. In order to do a complete review of the usability of the data, these items need to be reviewed for blank contamination and relative percent difference (RPD) determined. The above reviews are not typically done at the lab level and limits and applicable data qualifiers may not be included in the laboratory-specific SOPs. The U.S. EPA National Functional Guidelines for Organic Data review should be consulted for during the data review process.

RESPONSE: A data package including the requested information has been selected for this effort and is presented in Attachment C.

In addition to the in-house data review by First Environmental Laboratory, Clayton Group Services laboratory personnel will conduct an additional review of 10% of the data.

The sample identification/numbering system provided in Section 5.1 of this QAPP will be employed during the investigation activities.

COMMENT RESPONSES

7. *Response to Comment 138 of May 2002 Letter:*

Tables 13a and 13b need to indicate the dates of the MDL study. MDL study updates are required on a yearly basis and there is no way to currently determine if the information provided is still valid.

RESPONSE: Table 13 has been revised to identify the First Environmental Laboratory MDL and RQL information that will be used for this effort. The information is based on the First Environmental Laboratory MDL Final Study Reports referenced in Table 13 and included in Appendix B.

8. *EnChem SOP VOA-5 1/10/02:*

The reporting limits listed in the SOP do not match the reporting limits listed in Table 13a. For example, bromomethane and chloromethane are listed as 50 ug/kg in the SOP and at 100 ug/kg in QAPP table 13a. The SOP needs to be amended to reflect this project or the table needs to be updated. All reporting limits should be confirmed for both EnChem VOA SOPs.

RESPONSE: Same as #7.

Lockformer Work Plan

**The Lockformer Company
711 W. Ogden Avenue
Lisle, Illinois 60532**

Volume III: Quality Assurance Project Plan

Clayton Project No. 15-65263.01-010
February 28, 2003

Prepared for:
THE LOCKFORMER COMPANY
Lisle, Illinois

Prepared by:
CLAYTON GROUP SERVICES, INC.
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Quality Assurance Project Plan

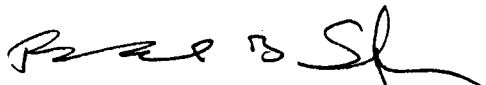
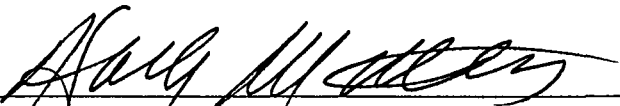
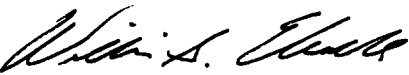
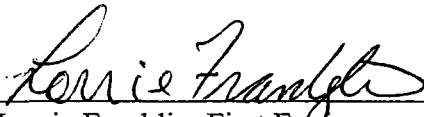
Lockformer Work Plan
The Lockformer Company
711 West Ogden Avenue
Lisle, Illinois
ILD0005110929

February 28, 2003

Submitted by:
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Submitted to:
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Prepared by:
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	2/28/03
Dr. Hank Mittelhauser, Clayton Quality Control Officer	Date
	2/28/03
William Elwell, Clayton Field Project Manager	Date
	2/28/03
Lorrie Franklin, First Environmental Laboratories, Inc., QA Manager	Date

CONTENTS

<u>Section</u>	<u>Page</u>
Contents	i
1.0 PROJECT DESCRIPTION	1
1.1 OVERALL PROJECT OBJECTIVES	1
1.2 SITE/FACILITY DESCRIPTION	3
1.2.1 Topography	4
1.2.2 Geology	5
1.2.3 Hydrogeology	7
1.3 PAST DATA COLLECTION ACTIVITIES	9
1.3.1 Past Data Collection Activities in Areas 1 and 2	9
1.3.2 Data Collection Activities in Area 3	12
1.4 DATA QUALITY OBJECTIVES	12
1.4.1 Current State of Investigation and Summary of Existing Problem	12
1.4.2 Identification of Key Decisions	15
1.4.3 Identification of Data Necessary to Satisfy Key Decision Making	16
1.4.4 Study Boundaries	17
1.4.5 Development of a Decision Rule	18
1.4.6 Specified Limits on Decision Errors	18
1.4.7 Optimization of the Design	20
1.5 FIELD SAMPLING PLAN	21
1.5.1 Additional Soil Sampling in Area 1	22
1.5.1.1 Area 1 Soil Borings in the Surficial Silty Clay Till/Fill	22
1.5.1.2 Area 1 Soil Borings in the Mass Waste Unit and Upper Surface of the Lower Till	23
1.5.2 Additional Soil Sampling in Area 2	25
1.5.2.1 Area 2 Soil Borings in the Surficial Silty Clay Till/Fill	25
1.5.2.2 Area 2 Soil Borings in the Mass Waste Unit and Upper Surface of the Lower Till	25
1.5.3 Additional Soil and Groundwater Investigations in Area 3	26
1.5.3.1 Area 3 Soil Borings	26
1.5.3.2 Area 3 Groundwater Monitoring Wells	28
1.5.4 Additional Surficial Drainage Way Sampling	31
1.5.5 Management of Investigation-Derived Materials	33
1.5.5.1 Management of Investigation-Derived Soils	34
1.5.5.2 Management of Investigation-Derived Liquids	34
1.5.6 Site Maps of Sampling Locations	34

CONTENTS*(Continued)*

<u>Section</u>	<u>Page</u>
1.6 PROJECT SCHEDULE.....	35
1.6.1 Anticipated Date of Project Mobilization	35
1.6.2 Project Timeframes	35
2.0 PROJECT ORGANIZATION AND RESPONSIBILITY	36
2.1 PROJECT ORGANIZATION CHART	36
2.2 MANAGEMENT RESPONSIBILITIES	36
2.2.1 USEPA On-Scene Coordinator	36
2.2.2 Lockformer Project Manager.....	36
2.2.3 Clayton Project Manager	37
2.3 QA RESPONSIBILITIES	37
2.3.1 Clayton QA Officer	37
2.4 LABORATORY RESPONSIBILITIES.....	37
2.4.1 Laboratory Project Manager	37
2.4.2 Laboratory Operations Manager.....	38
2.4.3 Laboratory QA Manager.....	38
2.4.4 Laboratory Sample Custodian	39
2.4.5 Laboratory Technical Staff.....	39
2.5 FIELD RESPONSIBILITIES.....	40
2.5.1 Clayton Field Project Manager	40
2.5.2 Clayton Technical Field Staff.....	41
3.0 QA OBJECTIVES FOR MEASUREMENT DATA	42
3.1 PRECISION	42
3.1.1 Definition.....	42
3.1.2 Field Precision Objectives	42
3.1.3 Laboratory Precision Objectives	42
3.2 ACCURACY	43
3.2.1 Definition.....	43
3.2.2 Field Accuracy Objectives.....	43
3.2.3 Laboratory Accuracy Objectives	43
3.3 COMPLETENESS.....	43
3.3.1 Definition.....	43
3.3.2 Field Completeness Objectives	44
3.3.3 Laboratory Completeness Objectives	44
3.4 REPRESENTATIVENESS	45
3.4.1 Definition.....	45

CONTENTS

(Continued)

<u>Section</u>	<u>Page</u>
3.4.2 Measures to Ensure Representativeness of Field Data.....	45
3.4.3 Measures to Ensure Representativeness of Laboratory Data.....	45
3.5 COMPARABILITY	45
3.5.1 Definition.....	45
3.5.2 Measures to Ensure Comparability of Field Data	46
3.5.3 Measures to Ensure Comparability of Laboratory Data	46
3.6 LEVEL OF QC EFFORT.....	46
 4.0 <u>SAMPLING PROCEDURES</u>	 48
 5.0 <u>CUSTODY PROCEDURES</u>	 49
5.1 FIELD CUSTODY PROCEDURES	49
5.2 LABORATORY CUSTODY PROCEDURES	52
5.3 FINAL EVIDENCE FILES.....	52
 6.0 <u>CALIBRATION PROCEDURES AND FREQUENCY</u>	 54
6.1 FIELD INSTRUMENT CALIBRATION	54
6.2 LABORATORY INSTRUMENT CALIBRATION.....	54
 7.0 <u>ANALYTICAL PROCEDURES</u>	 55
7.1 FIELD ANALYTICAL PROCEDURES	55
7.2 LABORATORY ANALYTICAL PROCEDURES	55
7.2.1 List of Project Target Compounds and Laboratory Detection Limits	56
7.2.2 List of Associated QC Samples	56
 8.0 <u>INTERNAL QC CHECKS</u>	 57
8.1 FIELD QC CHECKS	57
8.2 LABORATORY QC CHECKS	57
 9.0 <u>DATA REDUCTION, VALIDATION, AND REPORTING</u>	 58
9.1 DATA REDUCTION	58
9.1.1 Field Data Reduction Procedures	58
9.1.2 Laboratory Data Reduction Procedures.....	58
9.2 DATA VALIDATION	59
9.2.1 Procedures Used to Evaluate Field Data	59
9.2.2 Procedures to Validate Laboratory Data.....	59

CONTENTS

(Continued)

<u>Section</u>	<u>Page</u>
9.3 DATA REPORTING	60
9.3.1 Field Data Reporting	60
9.3.2 Laboratory Data Reporting	60
10.0 <u>PERFORMANCE AND SYSTEM AUDITS AND FREQUENCY</u>	61
10.1 FIELD PERFORMANCE AND SYSTEM AUDITS	61
10.1.1 Internal Field Audits	61
10.1.1.1 Internal Field Audit Responsibilities	61
10.1.1.2 Internal Field Audit Frequency	61
10.1.1.3 Internal Field Audit Procedures	61
10.1.2 External Field Audits	62
10.1.2.1 External Field Audit Responsibilities	62
10.1.2.2 External Field Audit Frequency	62
10.1.2.3 Overview of the External Field Audit Process	62
10.2 LABORATORY PERFORMANCE AND SYSTEMS AUDITS	62
10.2.1 Internal Laboratory Audits	62
10.2.1.1 Internal Laboratory Audit Responsibilities	62
10.2.1.2 Internal Laboratory Audit Frequency	63
10.2.1.3 Internal Laboratory Audit Procedures	63
10.2.2 External Laboratory Audits	63
10.2.2.1 External Laboratory Audit Responsibilities	63
10.2.2.2 External Laboratory Audit Frequency	64
10.2.2.3 Overview of the External Laboratory Audit Process	64
11.0 <u>PREVENTIVE MAINTENANCE</u>	65
11.1 FIELD INSTRUMENT PREVENTIVE MAINTENANCE	65
11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE	65
12.0 <u>SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA</u>	
<u>PRECISION, ACCURACY, AND COMPLETENESS</u>	66
12.1 ACCURACY ASSESSMENT	66
12.2 PRECISION ASSESSMENT	66
12.3 COMPLETENESS ASSESSMENT	67

CONTENTS*(Continued)*

<u>Section</u>	<u>Page</u>
13.0 <u>CORRECTIVE ACTION</u>	68
13.1 FIELD CORRECTIVE ACTION	68
13.2 LABORATORY CORRECTIVE ACTION	70
13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT	71

Figures

- 1 Site Location Map
- 2 Site Layout Map
- 3 Site Topographic Map
- 3A Site Topographic Map: 1962 / 2001
- 4 Cross Section Reference Map
- 5 Cross Section A-A'
- 6 Cross Section B-B'
- 7 Cross Section C-C'
- 8 Interior Investigation Layout Map
- 9 Building Basement Sump Sampling Results
- 10 Storm and Sanitary Sewer Sampling Locations and Results
- 11 Storm and Sanitary Sewer Survey
- 12A Soil Analytical Results in the Fill/Till at the 0-5' Depth Interval
- 12B Soil Analytical Results in the Fill/Till at the 5-10' Depth Interval
- 12C Soil Analytical Results in the Fill/Till at the 10-15' Depth Interval
- 12D Soil Analytical Results in the Fill/Till at the 15-20' Depth Interval
- 12E Soil Analytical Results in the Fill/Till at the 20-34' Depth Interval
- 12F Soil Analytical Results for the Mass Waste Unit
- 12G Soil Analytical Results for the Lower Till Unit
- 13 Cross Section Locations for SA-1/SA-1' and SA-2/SA-2'
- 14 Cross Section SA-1 -- SA-1'
- 15 Cross Section SA-2 -- SA-2'
- 16 Most Recent Groundwater Sampling Results in Areas 1 and 2
- 17 Summary of Soil Results from the 1500-Series Borings in Area 3
- 18 Summary of Groundwater Results from the 1500-Series Borings in Area 3
- 19 Area 1 and 2 Soil Boring Grid Layout
- 20 Soil Boring Location Map -- Former Degreaser Area
- 21 Soil Boring Location Map -- Mass Waste Unit
- 22 Area 3 Investigation Layout
- 23 Typical Shallow Well Construction Diagram
- 24 Typical Bedrock Well Construction Diagram
- 25 Surficial Drainage Way Sampling Map
- 26 Site Topographic Map: 1962 / 2001 (with superimposed borings)
- 27 Project Organization Chart

Tables

- 1 Summary of Removal Action Objectives (RAOs) and Delineation Objectives
- 2 Clayton Soil Borings Inside the Facility Building – Around the Storm and Sanitary Sewer and the Vapor Degreaser
- 3 Clayton Soil Boring Results – Around South Exterior Door
- 4 Soil Analytical Results – Sewer System Sediment
- 5 Soil Sample Results 1200-Series Borings in the Immediate Vicinity of the TCE Fill Pipe
- 6 Geotechnical Analyses – Soils in the Immediate Vicinity of the TCE Fill Pipe
- 7 Sample Results from Monitoring Wells – Completed in the Glacial Sediments during the Lockformer Groundwater Investigations
- 8 Sample Results – Single Packer Tests Performed during Drilling of the Bedrock Monitoring Wells
- 9 Sample Results – Double Packer Tests Performed on the Bedrock Monitoring Wells
- 10 Water Level Measurements – Groundwater Monitoring Wells, Staff Gages, and Stand-By Production Wells
- 11 Soil Analytical Results – 1500-Series Soil Borings Performed in Area 3
- 12 Groundwater Analytical – Area 3
- 13 First Environmental Laboratories Detection and Reporting Limits – Volatile Organics
- 14 Instrument Calibration Frequency
- 15 Summary of Analytical Procedures
- 16 Laboratory Preventative Maintenance and Schedules
- 17 Summary of Investigation Sampling and Analysis to be Performed
- 18 Sample Holding Times, Preservatives and Volume Requirements

Attachments

- A Field Standard Operating Procedures
- B Laboratory Standard Operating Procedures
- C Laboratory Quality Assurance Data Packages

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1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) outlines the overall scope of an investigation/removal action effort under the scope of the Lockformer Work Plan (LWP). The LWP is intended to provide information as required by the Unilateral Administrative Order (UAO), Docket No. V-W-02-C-665 issued by the United States Environmental Protection Agency (USEPA) to The Lockformer Company (Lockformer). This QAPP has been prepared on behalf of Lockformer by Clayton Group Services, Inc. (Clayton) to present the organization, objectives, planned activities, and specific Quality Assurance/Quality Control (QA/QC) procedures for the LWP for the Lockformer facility in Lisle, Illinois (Figures 1 and 2). Specific protocols for sampling, sample handling and storage, chain of custody, and laboratory and field analyses will be described. All QA/QC procedures will be structured in accordance with applicable technical standards, USEPA's requirements, regulations, and guidance. This QAPP has been prepared based on USEPA guidance, including the *EPA Quality Manual for Environmental Programs* (May 2000).

1.1 OVERALL PROJECT OBJECTIVES

The objectives of the LWP are as follows:

1. Perform soil investigations in Areas 1 and 2 of the site to determine the extent of removal action required.
2. To present the methods by which Areas 1 and 2 will be remediated to removal action objectives.
3. To collect the additional soil and groundwater data necessary to characterize the extent of contamination exceeding remediation objectives occurring in Area 3, and in preparation for designing and implementing a groundwater remediation system for the site.

Associated specific objectives for field and laboratory data collection are discussed in Section 1.4 of this QAPP.

Removal action objectives (RAOs) for the soil in Areas 1 and 2 have been developed through the combined effort of the USEPA, the Illinois Environmental Protection Agency (IEPA), the Illinois Attorney General (IAG), Lockformer, and their representatives. Individual RAOs have been established for the individual soil lithologies encountered at the site. The RAOs were developed in accordance with the potential risk that Volatile Organic Compounds (VOCs) in each lithology might present to human health and the environment. Table 1 identifies the various RAOs established for the site. Although migration to groundwater is a concern for contaminants present in the upper silty clay till/fill, the RAOs for this soil unit are based on the Tiered Approach to Corrective Action Objectives (TACO) Tier I Soil Remediation Objectives (SROs) for the protection of the Industrial/Commercial Inhalation exposure route established in Title 35 of the Illinois Administrative Code Part 742 (35 IAC 742). The RAOs established for the mass waste sand and gravel in Areas 1 and 2 consist of the TACO Tier I SROs for the protection of the Soil Component of the Class I Groundwater Ingestion Route established in 35 IAC 742. The RAOs established for soil in Area 3 consist of the most conservative SROs in 35 IAC 742.

Trichloroethene (TCE) concentrations in the soil at the Lockformer site are significantly higher than other VOCs at the site. As a result, TCE concentrations at the site have been used as a guide in the development of the investigation activities associated with the LWP. The investigation activities are discussed further in Section 1.5.

1.2 SITE/FACILITY DESCRIPTION

The site is located in south-central DuPage County, Illinois (Figure 1). The site consists of an east and west parcel that encompass a total of 18.5 acres (Figure 2). The east parcel (commonly referred to as the Lockformer parcel) is identified as Area 1. Area 1 consists of approximately 6.54 acres and is occupied by a single structure with associated landscaped and drive/parking areas. The structure is utilized by Lockformer as a manufacturing facility for production of sheet metal processing equipment and roll-forming machines. The west parcel (commonly referred to as the MetCoil parcel) has been divided into two separate areas. The northern portion of the MetCoil property will be referred to as Area 2, and the southern portion will be referred to as Area 3. The west parcel consists of approximately 11.96 acres of undeveloped land. The site is located in a mixed area of industrial, commercial and residential use (approximately 1,300 to 1,800 feet west of Interstate 355).

The site is bounded to the north by Ogden Avenue, beyond which exists a residential subdivision; to the east by the Bill Kay car dealership; to the south by a surface water retention basin servicing the Bill Kay property (beyond which exists single-family homes) and the Burlington Northern railroad (beyond which exists St. Joseph's Creek and residential homes); and to the west by a multi-unit commercial building.

Soil impacted by TCE was first discovered in the fall of 1991 during underground utility (water line) repair work conducted along the west side of the Lockformer manufacturing building. The TCE impacts to soil and groundwater in Areas 1 and 2 are believed to have been the result of filling operations of the roof-mounted TCE tank formerly located along the west side of the manufacturing building. The location of this tank can be reviewed in Figure 2. The tank was equipped with metal fill and vent pipes that extended down the west building wall to approximately 4 feet above grade.

1.2.1 Topography

Clayton obtained and reviewed a topographical survey for the vicinity of the site from DuPage County. The topographical information from 2001 for the site is illustrated in Figure 3. In general, the site's west parcel is higher in elevation than the east parcel. However, both parcels slope to the south/southwest. The eastern portion of the east parcel slopes east. A low-lying (ditch) right-of-way is located at the western edge of the east parcel and the eastern edge of the west parcel. Elevations on the east parcel range from approximately 714 feet above mean sea level (msl) adjacent to Ogden Avenue to approximately 700 feet above msl at the most southwestern portion of the parcel. Elevations on the west parcel range from approximately 714 feet above msl adjacent to Ogden Avenue to approximately 674 feet above msl at the southern portion of the parcel.

A drainage swale runs north to south between Areas 1 and 2, and along the east side of Area 3. Prior to approximately 1983, this drainage swale contained a headwall at approximately the boundary between Areas 2 and 3 where storm water collected from Area 1 was discharged to the swale. The swale then ran to the south along the east side of Area 3 to ultimately discharge into an east-west drainage feature at the very south end of Area 3, immediately north of the railroad tracks. In approximately 1983, the headwall in this drainage swale was taken out of service, and a new storm sewer line was installed east of the drainage swale in the West Avenue right-of-way. This storm sewer line runs to the south, down the West Avenue right-of-way, to an east-west storm sewer line that crosses the south end of Area 3. At approximately the time that the headwall was removed, a retention basin was installed on the southern end of the MetCoil property in Area 3 to collect surface water runoff from the MetCoil property.

Topographical information from 1962 for the site is superimposed on the existing site topographic profile and is illustrated in Figure 3A. A review of the information reveals

that the pre-development surface elevation of the site ranged from approximately 674 feet above msl to 725 feet above msl. The site sloped to the south, east, and west from its high point located centrally along the northern perimeter. A large portion of Area 2, Area 3, and Area 1 (via a drainage swale located along its east edge) discharged to a low-lying area located centrally in Area 3. A review of Figure 3A indicates that, generally, 8 to 10 feet of fill have been placed on Areas 2 and 3, north of the Area 3 retention basin.

1.2.2 Geology

The site is located within the Wheaton Morainal section of the Great Lakes physiographic province. Based on the Illinois State Geological Survey (ISGS) Circular 460 *Summary of the Geology of the Chicago Area - 1971*, the uppermost surficial glacial unit present at the site consists of undifferentiated Valparaiso Moraine deposits. The Valparaiso Moraine includes a buried drift of questionable age, informally called the Lemont Drift, which consists of yellow-gray silty till, sand and gravel, and dune sand. The deposits are generally overlain by a thin Richland Loess or modern soil (*Illinois State Water Survey/Ground Water Resources of DuPage County, Illinois - Cooperative Ground Water Report 2 - 1962*).

Since beginning investigative activities in 1992, a series of subsurface investigations have been conducted at the site to evaluate the extent of VOC contamination. The investigations have included the advancement of approximately 187 soil borings to facilitate the collection of discrete soil samples, and the installation of 78 monitoring wells to facilitate the collection of groundwater samples for chemical analysis. A large number of these soil borings and groundwater monitoring wells have been installed in Areas 1 and 2 to define the geology and the extent of contamination there.

Based on subsurface investigations conducted in Areas 1 and 2, the lithologies underlying the vicinity of the former TCE fill pipe consist of cohesive silty clay glacial till and fill from surface grade to a depth of approximately 25 to 30 feet (elevation of approximately 675 to 680 feet above msl). The silty clay is underlain by a mass waste deposit predominantly composed of unconsolidated sand and gravel that contains variable amounts of silt and clay. It is readily distinguished by its high percentage of angular gravel clasts composed of dolomite. It is typically very poorly sorted, and grades to a sand and silt toward the base of the deposit at some locations.

A cohesive clayey silt comprises the lower glacial till that underlies the mass waste deposit at an elevation of approximately 662 feet msl in the vicinity of the TCE fill pipe. The lower clayey silt till extends down to an approximate elevation of 643 to 650 feet msl, at which point it is underlain by a lower sand at some locations but extends to the weathered bedrock surface at most locations within Areas 1 and 2. The lower sand contains significant amounts of silt and clay.

In Areas 1 and 2, the upper weathered portion of the Silurian dolomite is encountered at an elevation of approximately 630 msl. The competent dolomitic bedrock surface typically occurs at approximately 620 to 625 feet msl.

A significant amount of topographic slope occurs from north to south on the MetCoil property and results in significantly lower surface grade elevations in Area 3. A retention basin has also been constructed in the south portion of Area 3. The net result of these topographic changes is that the surficial silty clay glacial till and fill gradually thins to the south to the point where the mass waste sand and gravel is exposed at surface grade within the retention basin. There also appears to be a transitional environment of deposition within the lower till unit. It appears that the lower till contains a higher percentage of sand where it was observed at monitoring well nest MW-1113. However,

the lithologies still exhibited a cohesive nature and, therefore, are indicative of high percentages of silt and clay. At this time, no borings have extended to bedrock along the south property boundary. As a result, the existence of the lower till within or below the mass waste sand and gravel, and above bedrock, in this portion of the site is undetermined.

Cross sections have been prepared to illustrate the sequence of lithologies described above and their lateral variation across the site. Figure 4 is a cross section reference map that shows the location of each cross section. Figure 5 presents cross section A-A'. Figure 6 presents cross section B-B'. Figure 7 presents cross section C-C'.

1.2.3 Hydrogeology

Investigations in Areas 1 and 2 indicate that groundwater occurs variably within the surficial silty clay till and fill. At some locations, wells completed in the surficial silty clay till and fill will encounter groundwater that will yield to a well and allow sampling. At other locations, wells completed in the surficial silty clay till and fill are dry. The surficial silty clay till and fill in Areas 1 and 2 generally occurs from surface grade to approximately 25 to 30 feet in depth.

Groundwater occurring within the surficial silty clay till and fill does not appear to form a water table condition. Instead, it appears groundwater variably occurs within the surficial silty clay till and fill, and is controlled by the occurrence of fractures and coarse-grain lithologies contained within the lithologic sequence.

The glacial mass waste sand and gravel occurs below the surficial silty clay till and fill. This mass waste sand and gravel is predominantly unconsolidated and exhibits significantly increased permeabilities over those in the surficial silty clay till and fill.

Some isolated portions of the mass waste unit across Areas 1 and 2 exhibit a loosely cohesive nature indicative of a greater percentage of fine-grained lithologies and lower permeabilities.

The investigations in Areas 1 and 2 indicate the mass waste unit across these areas is positioned above lower glacial till. This lower glacial till has been determined to be present below the mass waste sand and gravel over the entirety of Areas 1 and 2 in each boring drilled to its depth. The lower glacial till is composed of cohesive silts and clays. The upper surface of the lower silty clay glacial till occurs at an approximate elevation of 662 feet msl in the vicinity of the TCE fill pipe. The upper surface of the lower silty clay glacial till slopes down in areas to the west and south away from the TCE fill pipe.

The mass waste sand and gravel is unsaturated in the vicinity of the TCE fill pipe where extensive soil contamination occurs. The contact between the upper surface of the lower silty clay glacial till and the mass waste sand and gravel slopes down to the west and south away from the area of the TCE fill pipe. When the upper surface of the lower silty clay till surface occurs below an elevation of approximately 655 feet msl, groundwater saturates the mass waste sand and gravel sediments to form a water table condition.

Investigations in Area 3 have indicated the presence of a transitional environment of deposition in the lower till below the mass waste sand and gravel. A limited thickness of saturated sediments occurs in the coarse-grained sediments above the lower till in the vicinity of monitoring well nest MW-1113. At monitoring well nest MW-1113, a 6-foot clay separates the 3- to 4-foot-thick saturated zone in the mass waste unit from the saturated sediments below the lower till unit.

Further to the south in Area 3 along the southern boundary of the site, investigations have primarily been directed toward determining the extent of soil contamination related to

releases from the Lisle sanitary sewer system. As a result, the depth of investigation has extended down only to the water table. The water table in this area occurs within the mass waste sand and gravel at a depth of approximately 26 feet.

1.3 PAST DATA COLLECTION ACTIVITIES

A great deal of data has been collected at the Lockformer site to date. Recent investigations in Areas 1 and 2 have primarily focused on the releases that resulted from the manufacturing processes associated with (and potentially impacting the area under and around) the facility building and releases associated with the TCE fill pipe. The Area 3 investigations have been primarily focused along the drainage ways and the sanitary sewer system.

1.3.1 Past Data Collection Activities in Areas 1 and 2

Soil investigations related to the manufacturing processes at the Lockformer facility have primarily focused on the following areas within and directly around the facility building:

- The former TCE vapor degreaser.
- The sanitary and storm sewer lines and associated floor drains under the building floor.
- The south side door leading to the outside from the manufacturing operation.
- The basement area sump that collects water from the footing drains, and the secondary containment sump for the petroleum tank.

The results of all investigations performed around the former TCE vapor degreaser, the sanitary and storm sewer lines and associated floor drains under the building floor, and the south side exterior door are illustrated in Figure 8. The result of Clayton

investigations around the former TCE vapor degreaser and the storm and sanitary sewer lines are tabulated in Table 2. The results of the soil borings around the south exterior door leading to the manufacturing operation are summarized in Table 3.

The results of the two investigation borings performed in the Lockformer basement area adjacent to the footing drain sump and the sump in the secondary containment for the petroleum tank, are illustrated in Figure 9. The data from these borings in the basement is summarized in Table 2.

The storm and sanitary sewer catch basins and manholes in Areas 1 and 2 were inspected as part of the investigative work associated with the IEPA work plan. Where sediment was present in these catch basins and manholes, it was submitted for laboratory analysis. Figure 10 illustrates the catch basins and manholes in Areas 1 and 2 that were inspected and sampled. The results of the sediment sample analyses are indicated. Table 4 summarizes the laboratory analytical results from sampling these catch basins and manholes.

A series of trenches were previously excavated along the utility lines in Areas 1 and 2 to determine the nature of any contamination that might have been released from the sewer systems and/or migrating through any coarse-grained bedding material associated with the sewers or other utilities. The location of the excavations and results of samples taken from them to perform these investigations appear in Figure 10. The samples from these trenches were acquired as grab samples of the bedding material adjacent to the sewer pipe or utility line from a backhoe performing the excavation.

The storm and sanitary sewer catch basins and manholes at the Lockformer site, including invert elevations, have been surveyed and appear in Figure 11.

Soil investigations related to releases at the TCE fill pipe have been extensive. Figures 12A through 12G illustrate the soil sampling results for specific depth intervals obtained during investigations to define the extent of the TCE fill pipe releases. The results from recent investigations involving the 1200-series borings installed in the immediate vicinity of the TCE fill pipe are provided in Table 5. The results of geotechnical analyses of samples acquired from the 1200-series borings in the immediate vicinity of the TCE fill pipe are provided in Table 6.

Two cross sections in the immediate vicinity of the TCE fill pipe have been developed from the recently performed 1200-series borings. Figure 13 illustrates the locations for cross sections SA-1 to SA-1' and SA-2 to SA-2'. Figures 14 and 15 illustrate the sequence of lithologies in the vicinity of the former TCE fill pipe along cross sections SA-1 to SA-1' and SA-2 to SA-2'. Superimposed on cross sections SA-1 to SA-1' and SA-2 to SA-2' are soil sampling results for TCE and cis-1, 2-dichloroethene (DCE) and the potentiometric surface of the lower sand on November 30, 2001.

The most recent results of groundwater sampling from monitoring wells in Areas 1 and 2 are illustrated in Figure 16. All groundwater sample results appearing in Figure 16 were acquired in 2001. Sample results from monitoring wells completed in the glacial sediments during the Lockformer groundwater investigations and sampled since the January 25, 2001 Clayton report are tabulated and appear in Table 7. Sample results from the single packer tests performed during drilling of the bedrock wells during the Lockformer groundwater investigations are tabulated and appear in Table 8. Sample results from double packer tests performed on the bedrock monitoring wells during the Lockformer groundwater investigations are tabulated and appear in Table 9. Water level measurements acquired from monitoring wells completed in the glacial sediments and bedrock appear in Table 10.

1.3.2 Data Collection Activities in Area 3

The Area 3 soil investigations have primarily involved sampling along the drainage ways and the sanitary sewer system. Table 11 summarizes the data from these 1500-series soil borings performed in Area 3. Figure 17 summarizes the data collected in the 1500-series soil borings in Area 3.

The Area 3 groundwater investigations have been primarily focused along the drainage ways and the sanitary sewer system. Table 12 provides a tabulated summary of the analytical results for groundwater samples collected in Area 3. Figure 18 provides a summary of the groundwater sampling results from monitoring wells and groundwater grab sample results from the 1500-series soil borings in Area 3. Sample results from the single packer tests performed during the drilling of the MW-1113D bedrock well are tabulated and appear in Table 8. Sample results from double packer tests performed on bedrock monitoring well MW-1113D appear in Table 9.

1.4 DATA QUALITY OBJECTIVES

1.4.1 Current State of Investigation and Summary of Existing Problem

The current state of investigation at the Lockformer site is described in the Comprehensive VOC Investigation Report for the Lockformer site developed by Clayton, and dated May 10, 2002. The majority of these investigations have been under oversight by the IEPA. The most recent investigations have been performed according to the Comprehensive VOC Investigation Work Plan for the Lockformer site developed by Clayton and dated May 25, 2001. This work plan was approved by the IEPA on June 28, 2001.

A large volume of data currently exists for the Lockformer site, as a result of previous investigations. The May 10, 2002 Comprehensive VOC Investigation Report describes the hydrogeologic flow and routes of exposure for the site in great detail. Due to the large volume of data presented in that report and the analysis provided, it would be very difficult to summarize that data and analysis here. As a result, to gain an understanding of soil contamination impacts and the resulting surface water and groundwater routes of exposure, the May 10, 2002 Comprehensive VOC Investigation Report should be consulted.

Through numerous meetings with the USEPA, the IEPA, the IAG and their consultants a plan has been constructed for further evaluation and remediation of the Lockformer site. The primary participants during these planning meetings have included the following:

USEPA -	Steve Faryan, On-Scene-Coordinator (OSC)
R.F. Weston -	Om Patel
	Brian Voss
IEPA -	Stan Komperda
Parsons -	Rick Frendt
	Sasa Jazic
IAG -	Howard Chinn
Clayton -	Ron St. John
	Bill Elwell
Lockformer -	Rian Scheel
	Arthur Bourlard

The meetings held between the parties identified above have resulted in the following definition of exposure and scope of work under this Removal Action:

1. Protection of industrial worker safety – The soils to a depth of approximately 30 feet, where releases occurred in the vicinity of the former TCE fill pipe, will be remediated through the use of electrical resistive heating (ERH) to a RAO of 8.9 mg/kg to be protective of worker safety.

2. Protection of industrial worker safety – The shallow soils around the former vapor degreaser inside the Lockformer building where releases occurred will be excavated to the extent practicable to achieve a RAO of 8.9 mg/kg to be protective of worker safety.
3. Protection of groundwater – The mass waste unit sand and gravel that generally occurs from approximately 30 to 50 feet in depth in the vicinity of the former TCE fill pipe area will be remediated through use of soil vapor extraction (SVE) to a RAO of 0.060 mg/kg to be protective of a migration to groundwater potential.
4. Protection of groundwater – The lower till unit will be further investigated to determine if TCE concentrations greater than the saturation limit of 1,300 mg/kg occur in these silty clay lithologies in order to be protective of groundwater.
5. Protection of groundwater – The groundwater that saturates the lower portion of the mass waste sand and gravel in areas away from the former TCE fill pipe will be evaluated to determine the occurrence of dense non-aqueous phase liquid (DNAPL) TCE on top of the lower till or within the mass waste unit impacting groundwater. The criteria to be applied to this evaluation will be a TCE determination of greater than 1% of the soluble limit of TCE or 11 mg/L.
6. Protection of groundwater – Groundwater remediation related to the mass waste sand and gravel unit in Areas 2 and Area 3 will be the subject of a separate work plan under this Removal Action order.
7. Protection of groundwater – Groundwater remediation related to the Silurian Dolomite in Areas 1, 2 and 3 will be the subject of a separate work plan under this Removal Action order.
8. Protection of nearby receptors from surface water runoff – A significant portion of investigation in this Removal Action Work Plan (RAWP) is devoted to determining the impacts to surface soils and sediments resulting from surface water drainage away from the Lockformer site. The nature of this exposure or the potential exposure will be defined as a result of these investigations.
9. Protection of receptors from remediation system air discharges – A significant portion of this RAWP is devoted to the control and monitoring of the remediation system air discharges.

Based on the data collected during further investigations that is described by this RAWP,

the exact nature of the ERH and SVE remediation systems will be defined. The final design of these remediation systems will be submitted to the IEPA in the form of a technical memorandum. The further investigations outlined in this RAWP will also aid in the development of the groundwater remediation work plan to be submitted sometime after approval and implementation of this RAWP. It is the intent of these further investigations to satisfy the data quality objectives (DQOs) discussed and developed in the remainder of this section.

1.4.2 Identification of Key Decisions

The principle study questions that require further data collection to allow key decisions and design work to be carried out are identified as follows:

1. The extent of contamination greater than 8.9 mg/kg in the shallow till/fill soils will impact the location and design of the ERH remediation system.
2. The extent of contamination greater than 0.060 mg/kg in the mass waste sand and gravel will impact the location and design of the SVE remediation system.
3. The concentration of TCE determined to be present in the unsaturated, upper surface of the lower till will impact if remedial measures need to be implemented to address this lithology.
4. The concentration of TCE determined to be present in groundwater in the mass waste unit groundwater will determine the need for taking additional measures to remediate the groundwater occurring there.
5. The determination as to the existence of TCE in surface soils and sediment along surface drainage ways will determine whether remedial measures are required along these surficial drainageways.

There is the possibility that the further data collection defined by this RAWP will result in the inability to make the key decisions identified above. To the extent possible,

Clayton will review all data as it is acquired, and identify its adequacy for resolving the key questions and decisions making. In the event that a significant data gap still exists after the RAWP investigation efforts are completed, it will be necessary to discuss these data gaps with USEPA personnel and define measures necessary to satisfy these data gaps as soon as reasonably possible.

1.4.3 Identification of Data Necessary to Satisfy Key Decision Making

The following data inputs are necessary to satisfy the key decision making related to investigation tasks under this RAWP:

1. The volume of soil in the upper till exceeding 8.9 mg/kg will need to be identified at the completion of the further field investigations under this RAWP.
2. The volume of soil in the mass waste unit sand and gravel exceeding 0.060 mg/kg will need to be identified at the completion of the further field investigations under this RAWP.
3. The occurrence of TCE concentrations in excess of 1,300 mg/kg (if determined in the unsaturated, upper surface of the lower till in areas where the mass waste unit is being investigated) will require further field investigations under this RAWP.
4. The occurrence of TCE concentrations in groundwater of the mass waste unit exceeding 11 mg/L will require further field investigations under this RAWP.
5. The occurrence of TCE in surficial drainageway soils and sediments will be necessary to determine compliance to the most stringent action level of 0.060 mg/kg for migration to groundwater; otherwise, further field investigations under this RAWP will be necessary.

In all instances, the analytical methods identified in this RAWP will be capable of identifying whether the data collected meets the applicable data decision-making requirements.

1.4.4 Study Boundaries

The Lockformer site has been divided into three areas. The boundaries for Areas 1, 2 and 3 are identified in Figure 1.3-2. It is currently anticipated that all the investigations included in this RAWP will be performed within Areas 1, 2 and 3, with the exception of the following:

1. Investigations taking place east and west off of the Lockformer site at the south end of Area 3 along the Lisle sanitary sewer to determine the extent of contamination related to releases from this sewer system.
2. Investigations taking place to the east off of the Lockformer site along the Lockformer sanitary sewer east of Area 3 to determine the extent of contamination related to releases from this sewer.
3. Investigations taking place south of Area 1 to determine the extent of contamination related to surface water drainage off of the Lockformer site.

The onsite investigations to define the extent of contamination in Areas 1 and 2 will generally be advanced to the water table in the mass waste unit or the upper surface of the lower till, whichever is encountered first. The sewer investigations will be advanced to the water table and will be completed by acquiring a groundwater grab sample at each location. The surface water drainage way sampling will be advanced to the upper till and mass waste unit contact, and will only be advanced further if contamination is indicated.

The investigations outlined in this RAWP will be performed as soon as reasonably possible upon approval of the plan. A schedule is provided in Section 7 of this RAWP that identifies the timing of investigation, design and remedial system implementation.

1.4.5 Development of a Decision Rule

The decision rule for investigations related to the Lockformer site can be straightforwardly defined as follows:

If the lateral and vertical extent of contamination has not been defined to the applicable action level for any contamination source, then further investigation will be performed to provide adequate definition.

The decision rule for remediation activities related to the Lockformer site can be defined as follows:

- If the confirmatory sampling does not indicate that the applicable action level has been achieved to a 95% confidence level (to a maximum of 10 mg/kg), then further application of remediation efforts will continue until the action level has been achieved to a 95% confidence level (to a maximum of 10 mg/kg); or until the USEPA determines that the practicable limits of the remedial technology have been achieved.

Further discussion of the confirmation sampling and achieving the 95% confidence limit to meet the remediation action levels is provided in Section 5 of this RAWP. The QAPP incorporated within this RAWP has been developed with the identified action levels in mind; and it ensures that the analytical detection limits will allow reliable comparisons with the action levels identified.

1.4.6 Specified Limits on Decision Errors

Investigation error related to sampling programs is generally related to two main components: sampling design error and measurement error. Sampling design error is influenced by the sample collection design, the number of samples collected, and the

actual variability of the population over space and time. Measurement error is a result of inaccuracies in the analytical methods utilized or the use of different analytical methods. Both of these types of errors can lead to decision error related to the goals of the project.

There is at least the likelihood that some degree of error has been introduced into the data collected at the Lockformer site to date, as a result of the following:

1. Different analytical laboratory techniques.
2. Sampling location bias resulting from sample acquisition in a non-uniform manner.
3. Temporal distribution of sample acquisition.
4. Sampling techniques employed by different investigators.

Significant investigation of the source areas in the vicinity of the former TCE fill pipe and vapor degreaser have been made. Previous investigations suggest that the TCE level in the upper till range from non-detect to concentrations in excess of the saturation limit in soils for TCE. The concentration range for TCE in the mass waste unit sand and gravel is significantly smaller and ranges from non-detect to approximately 42 mg/kg.

Given the investigation data development for the source areas on the site to date, and the impending remedial measures that will be implemented, it is reasonable to only expend resources currently to determine the lateral definition of the source areas. These investigations are being conducted on a quasi-grid pattern based on previous investigation results with the intent that the areas of remediation system implementation will be defined as a result. This level of definition is appropriate since the remedial technologies to be implemented have been demonstrated to reduce concentrations of TCE from levels above the soil saturation limit to the action levels defined for the Lockformer site. As a result, decision error should be minimized.

Sampling design error and measurement error throughout the remainder of the

investigations employed at the Lockformer site should be minimized to the extent possible, as a result of the following:

1. Use of consistent analytical laboratory techniques.
2. Use of uniform sample acquisition based on grid sampling when possible.
3. Collection and analysis of data over a limited time frame.
4. Consistent sampling techniques based on uniform work plan design.

At this stage in the Lockformer site evaluation and remediation, the decision goal performance evaluation is relatively straightforward. This is the result of the soil remediation efforts being required to meet the requirements of the confirmatory sampling program in Section 5, and Lockformer's commitment to perform groundwater containment of all impacted mass waste and Silurian dolomite groundwater. As a result, statistical analyses are applied to confirmation sampling programs for areas of soil contamination to define when the RAOs have been achieved, and the groundwater containment systems will have a requisite degree of "over-capture" to reduce concern regarding decision error.

1.4.7 Optimization of the Design

The data sampling and analysis design for generating data that is expected to satisfy the DQOs for this RAWP have been the result of numerous meetings and discussions between the USEPA, the IEPA, the IAG and their consultants. It is fair to say that through this process, evaluation and re-evaluation of the DQOs have taken place. The current version of the RAWP and the DQOs incorporated into it will need to be modified in the future with submittal of the groundwater remediation work plan.

1.5 FIELD SAMPLING PLAN

This Field Sampling Plan (FSP) addresses field procedures to be implemented by Clayton and its subcontractors during the additional investigations at the Lockformer site required to satisfy the investigation objectives of the LWP. This FSP has been prepared in accordance with the UAO, appropriate guidance documents, and good engineering practices.

The purpose of the investigation is to collect data to further evaluate the presence of VOCs at the site. The field activities performed during the evaluation will consist of:

1. Additional soil sampling in Area 1.
2. Additional soil sampling in Area 2.
3. Additional soil and groundwater investigations in Area 3.

The data will be used to define the areas within Areas 1 and 2 that will require remediation during this removal action under the scope of the LWP and to define the limits of contamination in the vicinity of Area 3, so that a remedial strategy can be developed. The anticipated investigation sampling program (including QA/QC samples) is summarized in Table 17.

The need for changes in the investigation activities may be identified upon completion of tasks during the investigation. If needs for additional or modified investigations are identified, revisions to this FSP will be prepared in the form of technical memoranda to address the performance of the additional activities. The additional or modified investigations that are the subject of the technical memoranda will be approved in writing by the USEPA On-Scene Coordinator (OSC) prior to implementation.

Section 5 of the LWP provides the conceptual confirmatory sampling plan that will be implemented for Areas 1 and 2. This FSP does not include those confirmatory sampling activities. The confirmatory sampling plan will be submitted as an addendum to the QAPP for USEPA approval at later stage.

1.5.1 Additional Soil Sampling in Area 1

The site data collection information in Section 1.3 identifies the current delineation of VOCs in Area 1. Additional soil sampling will be conducted in Area 1 to define the extent of VOC concentrations within the surficial silty clay till/fill and mass waste unit that exceed the RAOs described in Section 1.1. The additional delineation data will assist in the efficient implementation of the remedial technology employed to achieve RAOs.

1.5.1.1 Area 1 Soil Borings in the Surficial Silty Clay Till/Fill

Soil boring locations to delineate the extent of VOCs within the surficial silty clay till/fill exceeding RAOs for Area 1 will be performed in the former TCE fill pipe area and in the vicinity of the former degreaser. Soil boring locations in the TCE fill pipe area will be determined using the sampling grid layout illustrated in Figure 19. The sampling grid illustrated will take place on 25-foot centers. The soil boring locations in the vicinity of the former degreaser are illustrated in Figure 20.

Soil borings will be advanced using direct-push sampling methods to collect soil samples. Soil samples will be collected continuously using a 2-inch-diameter, 4-foot-long steel sampling tube and acetate inner sleeve. Additional information regarding direct-push sampling methods is provided in Standard Operating Procedure (SOP) No. 200 in Attachment A. Soil borings advanced in Area 1 in the vicinity of the TCE fill pipe will extend to the upper surface of the mass waste sand and gravel unit. Soil borings

advanced in the vicinity of the former degreaser will extend to approximately 16 feet below ground surface (bgs). Each sampling tube will be split into 2-foot intervals, then described and logged by a Clayton geologist according to the Unified Soil Classification System (USCS). Upon acquisition, a portion of each 2-foot sample will undergo headspace screening to determine the presence of organic vapors using a photoionization detector (PID). Details regarding headspace analysis are provided in SOP No. 330 in Attachment A. Samples collected from the vicinity of the TCE fill pipe will be chosen for VOC laboratory analysis based on the highest headspace concentration identified within each 10-foot section of the soil boring. Samples collected from the degreaser area will be chosen for VOC laboratory analysis based on the highest headspace concentration identified within each 4-foot sampling tube. Laboratory analysis will be conducted by First Environmental Laboratories, Inc. (First Environmental) of Naperville, Illinois. Soil borings in the vicinity of the Area 1 TCE fill pipe will continue in the grid-pattern fashion until concentrations below the RAOs have been identified. If the RAOs are exceeded on the outside perimeter of the grid, additional sampling will take place on 25-foot centers expanding the grid until the area of soils exceeding the RAOs is defined.

1.5.1.2 Area 1 Soil Borings in the Mass Waste Unit and Upper Surface of the Lower Till

Soil boring locations to delineate the extent of VOCs within the mass waste sand and gravel unit exceeding RAOs for Area 1 are illustrated in Figure 21.

Soil boring locations outside the site building will be advanced using rotasonic sampling methods to collect soil samples. Soil samples will be collected continuously using a 4-inch-diameter, 10-foot-long steel sampling tube advanced within a secondary casing. The rotasonic sampling method has been selected for the mass waste sand and gravel unit, because of its ability to retrieve continuous soil samples within very coarse materials that

would promote sampler refusal using most alternative methods. Additional information regarding rotasonic sampling methods is provided in SOP No. 200 (see Attachment A). Due to space limitations, soil boring locations inside the building will be advanced using hollow stem auger (HSA) drilling techniques with continuous soil sampling using standard 2-foot split spoons. If auger refusal occurs during drilling, the drillers will make every practical attempt to drill past the refusal point. If after exhausting all practical options, the HSA is encountering refusal, the boring will be terminated, and drilling will continue on the next boring identified in Figure 21.

Soil borings advanced to define the limit of the mass waste sand and gravel unit that exceeds RAOs will extend into the upper surface of the lower till unit or the groundwater table, whichever is encountered first. Determining contact with the groundwater table at the site will be assisted by comparing the elevation of any saturated conditions observed during boring activities to the groundwater table elevation of 655 feet above mean sea level that has been generally observed across the site. In this manner, saturated conditions encountered at elevations above 655 feet above mean sea level will not cause the premature termination of the soil boring. Rotasonic methods will incorporate continuous sample collection throughout the depth of each boring. For soil boring locations inside the building, soil sampling will begin at the upper surface of the mass waste sand and gravel unit. Each sampling tube will be split into 2-foot intervals, then described and logged by a Clayton geologist according to the USCS. Upon acquisition, a portion of each 2-foot sample will undergo headspace screening to determine the presence of organic vapors using a PID. Samples will be chosen for VOC laboratory analysis based on the highest headspace concentration identified within each 10-foot section of the soil boring within the unsaturated mass waste unit. A sample will also be collected from the upper surface of the lower till at each applicable soil boring location and submitted for VOC laboratory analysis. Laboratory analysis will be conducted by First

Environmental of Naperville, Illinois. Soil borings will continue until the extent of VOCs in the mass waste sand and gravel unit exceeding RAOs is identified.

1.5.2 Additional Soil Sampling in Area 2

The site data collection information in Section 1.3 identifies the current delineation of VOCs in Area 2. Additional soil sampling will be conducted in Area 2 to define the extent of VOC concentrations within the surficial clay till/fill and mass waste unit that exceed the RAOs described in Section 1.1. The additional delineation data will assist in the efficient implementation of the remedial technology employed to achieve RAOs.

1.5.2.1 Area 2 Soil Borings in the Surficial Clay Till/Fill

Soil boring locations to delineate the extent of VOCs within the surficial silty clay till/fill exceeding RAOs for Area 2 will be determined using the sampling grid layout illustrated in Figure 19. Soil borings will continue in the grid-pattern fashion until concentrations below the RAOs have been identified. Soil sample collection and analysis will be conducted in the same manner discussed in Section 1.5.1.1 for the TCE fill pipe area.

1.5.2.2 Area 2 Soil Borings in the Mass Waste Unit and Upper Surface of the Lower Till

Soil boring locations to delineate the extent of VOCs within the mass waste sand and gravel unit exceeding RAOs for Area 2 are illustrated in Figure 21. Soil sample collection and analysis will be conducted in the same manner discussed in Section 1.5.1.2 for boring locations outside the site building.

1.5.3 Additional Soil and Groundwater Investigations in Area 3

A review of the past data collection information in Section 1.3 identifies the presence of VOCs in both the soil and groundwater in Area 3. Investigations to date indicate there may be VOC contamination associated with the sewer systems that run along the eastern and southern portions of Area 3. Additional soil and groundwater sampling will be conducted in Area 3 to further define the extent of VOC concentrations exceeding objectives.

1.5.3.1 Area 3 Soil Borings

Soil boring locations to delineate the extent of VOCs exceeding the objectives established for Area 3 are illustrated in Figure 22. Soil borings will be advanced in 50-foot intervals along the length of the Lisle sanitary sewer line extending east and west of the Lockformer property, provided that access to this property is acquired by USEPA. Additionally, soil borings will be advanced along the eastern limit of West Avenue (located immediately east of Area 3) to evaluate the presence of VOC in the soil and groundwater in that area. At each sampling location, continuous soil samples will be acquired using direct-push soil sampling techniques until saturated conditions are encountered or sampling refusal occurs. Soil sampling and analysis will be conducted in the same manner that was described in Section 1.5.1.1 for soil borings in the TCE fill pipe area.

Once saturated conditions are encountered, a slotted steel screen will be temporarily advanced into the saturated zone via direct-push methods, or a new polyvinyl chloride (PVC) screen will be temporarily placed through the open borehole into the saturated zone to facilitate the collection of a groundwater grab sample. The groundwater sample will be collected by inserting new PVC tubing into the screen and withdrawing the tube to

allow drainage into laboratory-supplied sample containers. The groundwater samples will be submitted to First Environmental to be analyzed for the presence of VOCs.

Soil and groundwater sampling will continue along the sanitary line in a phased approach until the soil and groundwater samples from three consecutive borings exhibit VOC concentrations below the Area 3 objectives established in Section 1.1. The phased approach will consist of the initial advancement of four to five soil borings (based on a typical day of direct-push sampling) extending to the east and four to five soil borings extending to the west, along the sanitary line. Samples collected from these soil borings and selected for potential VOC analysis will be submitted to First Environmental. Samples collected from the closest three locations in each direction will be selected for initial VOC analysis, while the remaining samples will be archived. If laboratory results identify VOC concentrations exceeding objectives, the archived samples collected from the next boring in sequence will be analyzed, and so on until the soil and groundwater samples from three consecutive borings exhibit VOC concentrations below the Area 3 objectives. If additional soil borings are required, another round of soil borings will be advanced in both directions and the sequence of VOC analysis will continue.

Additionally, one soil boring will be advanced to a depth of 22 feet bgs immediately adjacent to CSB-1528. Soil sampling will be conducted in the same manner that was described in Section 1.5.1.1 for soil borings in the TCE fill pipe area. The soil sample between 12 feet bgs (the base of CSB-1528) and 22 feet bgs with the highest headspace field screening result will be selected for laboratory VOC analysis. The soil sample collected from the base of the soil boring will also be collected for laboratory analysis (given unsaturated conditions).

1.5.3.2 Area 3 Groundwater Monitoring Wells

Ten groundwater monitoring wells will be completed in the southern perimeter of Area 3 to further define the extent of groundwater VOC concentrations exceeding objectives in the glacial sediments and evaluate the presence of VOC concentrations in groundwater from the bedrock.

Seven wells will be installed to complete three well clusters located between the southern property boundary and the Village of Lisle sanitary sewer line. Each well cluster will consist of three adjacent monitoring wells: one well completed in the shallow water-bearing glacial sediments, one well completed in the deep water-bearing glacial sediments, and a monitoring well completed in the water-bearing bedrock. The shallow well coverage for two of the well clusters will be provided by existing monitoring wells MW-1115 and MW-1116. The remaining three wells will consist of shallow groundwater monitoring wells advanced north of the sanitary sewer line. The location of these wells was influenced by a series of overhead electrical power lines that extend east-west along the southern portion of the site. The location of the additional wells is illustrated in Figure 22.

Monitoring Well Installation Procedures

Well installation activities in each of the three well cluster locations will be initiated with the advancement of an 8-inch ID temporary casing using rotasonic methods, while performing continuous soil sampling until competent bedrock is encountered. Soil sampling will be conducted in a similar manner to that discussed in Section 1.5.1.2 for rotasonic sampling. However, since the well clusters are located in an area that has been investigated for the presence of soil impacts, soil samples will not be selected for laboratory analysis.

Upon reaching competent bedrock, a permanent steel casing will be installed through the temporary casing and grouted in place. This initial boring will define the sequence of lithologies above bedrock at that location and facilitate the proper installation of the more shallow wells in the cluster.

Following a minimum period to allow the permanent steel surface casing to set, rotasonic techniques will be employed to drill into the competent bedrock beneath the casing. Each hole will initially be cored approximately 50 feet into the competent rock. A typical bedrock monitoring well construction plan is illustrated in Figure 24. The bedrock cores will be collected using rotasonic coring techniques. The bedrock cores will be analyzed in detail and logged for reporting purposes. The rock core will be marked, labeled, and placed in wooden core boxes to preserve the exact nature of the retrieved core to the extent practicable. Clayton will keep the rock cores in a safe location to allow subsequent review and analysis. Additional information regarding coring procedures is provided in SOP No. 200. Each of the bedrock wells will remain as open coreholes.

At each well cluster location, adjacent monitoring wells will be installed in the unconsolidated glacial water-bearing sediment to complete the three well clusters. The installation of the wells will be facilitated using rotasonic methods. Wells finished in the shallow water-bearing glacial sediments will be completed with a 10-foot well screen positioned so that 8 feet of the screen is below the water table. Wells finished in the deep water-bearing glacial sediments will be completed with a 10-foot well screen positioned immediately above bedrock or lower till unit (if encountered). Upon reaching the final completion depth, a monitoring well will be installed through the rotasonic drill casing. Monitoring wells will be constructed using flush-threaded 2-inch ID stainless steel, 0.010-inch machine-slotted screens, and 2-inch ID stainless steel risers. No adhesives, solvents, or grease will be used. The top of the riser for monitoring wells will be situated

above grade and will be secured with an expandable locking cap with a hole drilled through its center.

A sand filter pack will be installed adjacent to the screen via tremie line and will extend to a height of approximately 2 feet above the upper screen interval. A minimum 2-foot bentonite pellet seal will be placed over the sand filter pack, and the annular seal will be hydrated with tap water. A bentonite/grout mix will be placed above the bentonite pellets to within 5 feet bgs. The rotasonic casing will be raised incrementally during placement of the sand pack, annular seal, and grout. An above-grade locking protective casing will be installed over the monitoring wells and set in concrete. The remaining annular space will be filled with concrete to secure the protective locking cover and to form a concrete pad at grade. A typical monitoring well construction plan for wells completed in water-bearing sediments is illustrated in Figure 23. Additional information regarding well installation procedures is presented in SOP No. 210 (see Attachment A).

The shallow wells completed north of the sanitary sewer line will be installed using hollow stem augers. The wells will be constructed in the same manner discussed for the shallow wells of the well clusters.

Well Development and Sampling

Development and sampling of the bedrock wells will be conducted using a double packer system. The double packer system consists of two inflatable bladders that are positioned at the top and bottom of a length of perforated pipe. The double packer system is able to isolate a discrete length of open corehole for development and/or groundwater sampling. This is accomplished by lowering the double packer assembly to the desired section of corehole and inflating the bladders to create a seal with the corehole walls, isolating the

section of corehole between the bladders. Water from the isolated section of corehole can then be accessed through the perforated pipe located between the bladders.

The double packer system will be constructed with 8 feet of perforated pipe between the bladders, enabling 8 feet of corehole to be isolated at one time. Development of each 8-foot length of corehole will include the removal of any water lost to that section during coring, plus an additional 300 gallons, using a submersible pump. During development, water level measurements will be collected every 15 minutes from the remaining monitoring wells of the subject cluster, as well as the nearest bedrock well. If dry conditions are encountered within an isolated section, development activities will be abandoned after 30 minutes of attempted water removal. Decontamination of the double packer equipment will be conducted between monitoring well locations in accordance with SOP No. 500 (see Attachment A). After development of an isolated section, groundwater samples will be collected for VOC analysis using bladder pump sampling methods in accordance with SOP 410 (Attachment A). Development water will be managed as described in Section 1.5.6.

Wells completed in the water-bearing glacial sediments will be developed using the pumping techniques presented in SOP 212 and sampled for VOC analysis using bladder pump sampling methods in accordance with SOP 410 (see Attachment A). In the case of mechanical failure during development or sampling, bailer techniques will be used in accordance with SOPs 212 and 410.

1.5.4 Additional Surficial Drainage Way Sampling

Soil sampling will be performed along the historical drainage ways at the locations identified in Figure 25. The intent of this sampling will be to determine if any contamination has been transported away from the area of the facility building through

existing and historical drainage ways at the site. At each sampling location, continuous soil samples will be acquired throughout the depth of the boring, unless otherwise noted. A review of the 1962 topographic information illustrated in Figure 26 reveals that the pre-development surface elevation for the proposed surface drainage way borings in Areas 1 and 2 ranged from approximately 690 feet above msl to 710 feet above msl. A review of Figures 5, 6, and 7 indicates that the upper surface of the mass waste sand and gravel unit in the proposed surficial drainage way boring locations in Areas 1 and 2 exists as high as 680 feet above msl. Based on this information, it appears that a minimum of several feet of the surficial silty clay till has existed in the vicinity of the proposed locations throughout the development of the site. Therefore, the Area 1 and 2 borings (with the exception of CSB1906) will be advanced through the surficial silty clay till/fill to the top of the mass waste sand and gravel unit. Based on investigations at the site to date, headspace field screening results exceeding 10 parts per million (ppm) have typically identified VOC concentrations exceeding objectives. Therefore, if headspace field screening results indicate 10 ppm VOC concentration in the soil sample collected at the contact of the surficial silty clay till/fill and the mass waste sand and gravel, that boring will continue to point where impacts are no longer identified or groundwater is encounter, whichever is first.

CSB1906 will be advanced to the top of bedrock to better define the geology in the southern portion of Area 1. However, upon reaching saturated soil conditions in CSB1906, PID field screening will not be performed, and soil samples will not be collected for laboratory VOC analysis.

Surface drainage way boring locations for Area 3 have been determined using a 50-foot sampling grid set on a historically low area of the site. Based on a review of the surface elevation of the mass waste sand and gravel unit in Figure 5 and the 1962 topographic information in Figure 26, it appears that only limited surficial silty clay till existed at

these locations. Therefore, proposed soil boring locations CSB1914 through CSB1923 will be advanced to the upper surface of the lower till or until saturated conditions are encountered. At each location where saturated conditions are encountered, a groundwater grab sample will be acquired in a manner similar to that described in Section 1.5.3.1 and submitted for laboratory VOC analysis. Soil boring locations CSB1914, CSB1919, and CSB1923 will continue to the top of bedrock to better define the geology in this area.

Each surface drainage way soil boring will be advanced using direct-push techniques, with the exception of those soil borings continuing to bedrock, which will be advanced using rotasonic techniques. If direct-push techniques are unsuccessful for the Area 3 locations (due to repetitive sampler refusal in the mass waste sand and gravel), then rotasonic sampling techniques will be used in Area 3.

Upon acquisition of a soil core, each sample will undergo headspace screening to determine the presence of organic vapors by PID. Soil samples will be collected for potential laboratory analysis and selected for laboratory analysis in the manner described in Section 1.5.1.1 for the TCE fill pipe area.

1.5.5 Management of Investigation-Derived Materials

Investigation-derived material will be generated during the implementation of many activities included in this FSP. Such materials will include soil cuttings from drilling/coring activities, monitoring well development water, and equipment decontamination water, etc.

1.5.5.1 Management of Investigation-Derived Soils

Soil cuttings brought to the surface during drilling activities will be containerized and staged at the southern end of the site's west parking lot. All materials will be characterized, labeled as to their contents and date of origin, and transported for offsite disposal in a properly licensed disposal facility.

1.5.5.2 Management of Investigation-Derived Liquids

Decontamination water and groundwater generated during development or purging of monitoring wells will be containerized in an aboveground storage tank with secondary containment, located at the southern end of the site's west parking lot. All materials will be characterized, labeled as to their contents and date of origin, and transported for offsite disposal in a properly licensed disposal facility.

1.5.6 Site Maps of Sampling Locations

Maps showing intended sampling locations are included in Figures 19-22, and 25. It is possible, however, depending on the nature of encountered field conditions, that some of these locations will be changed. The person who shall be responsible for making such decisions will be the Clayton Field Project Manager, whose responsibilities are described in Section 2.5 of this QAPP.

1.6 PROJECT SCHEDULE

1.6.1 Anticipated Date of Project Mobilization

The earliest date for which samples are planned to be collected is 14 days after approval of this QAPP.

1.6.2 Project Timeframes

The dates of projected milestones are presented in the LWP.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

At the direction of the USEPA OSC, Steve Faryan, Lockformer has overall responsibility for all phases of the LWP. Clayton will perform the field investigations and remedial activities identified in the LWP. Project management will also be provided by Clayton. The various quality assurance, field, laboratory and management responsibilities of key project personnel are defined below.

2.1 PROJECT ORGANIZATION CHART

The lines of authority for this specific project can be found in Figure 27, the proposed Project Organization Chart. This chart includes all individuals discussed below.

2.2 MANAGEMENT RESPONSIBILITIES

2.2.1 USEPA On-Scene Coordinator

Mr. Steven Faryan will function as the OSC for the USEPA on this project. All discussions, requests, reporting (including monthly progress reports, technical memoranda, requests for completion approval), and final reports will be directed to Mr. Faryan or his designee.

2.2.2 Lockformer Project Manager

Mr. J.R. Svehla will be the Lockformer Project Manager for this project. He has general oversight and project management responsibilities. He is responsible for completing the project to the satisfaction of the Agency.

2.2.3 Clayton Project Manager

Mr. Ron St. John will serve as the Project Coordinator for Lockformer. Mr. St. John will be responsible for Lockformer's project administration; and the overall project management, coordination, and reporting to USEPA.

2.3 QA RESPONSIBILITIES

2.3.1 Clayton QA Officer

The Clayton QA officer, Dr. Hank Mittelhauser, will be responsible for ensuring that all Clayton procedures for this project are being followed, except for data validation, which will be performed by the Laboratory QA Manager.

2.4 LABORATORY RESPONSIBILITIES

The information presented in this section is applicable to each laboratory providing services during this project.

2.4.1 Laboratory Project Manager

The Laboratory Project Manager will report directly to the Clayton Project Manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available on an as-required basis.
- Overviewing of final analytical reports.

2.4.2 Laboratory Operations Manager

The Laboratory Operation Manager will report to the Laboratory Project Manager and will be responsible for:

- Coordinating laboratory analyses.
- Supervising in-house chain of custody.
- Scheduling sample analyses.
- Overseeing data review.
- Overseeing preparation of analytical reports.
- Approving final analytical reports prior to submission to the Clayton Project Manager.

2.4.3 Laboratory QA Manager

The Laboratory QA Manager has overall responsibility for data that leaves the laboratory. The Laboratory QA Manager will be independent of the laboratory, but will communicate data issues through the Laboratory Project Manager. If issues are not satisfactorily resolved, the Laboratory QA Manager will report the problem to the Clayton Project Manager. The Clayton Project Manager has ultimate authority to resolve QA disputes.

In addition, the Laboratory QA Manager will:

- Overview laboratory quality assurance.
- Overview QA/QC documentation.
- Conduct detailed data review.
- Determine whether to implement laboratory corrective actions, if required.
- Define appropriate laboratory QA procedures.
- Review laboratory SOPs.
- Sign the title page of the QAPP.

2.4.4 Laboratory Sample Custodian

The Laboratory Sample Custodian will report to the Laboratory Operations Manager.

Responsibilities of the Laboratory Sample Custodian will include:

- Receiving and inspecting the incoming sample containers.
- Recording the condition of the incoming sample containers.
- Signing appropriate documents.
- Verifying chain of custody and its correctness.
- Notifying Laboratory Manager and Laboratory Supervisor of sample receipt and inspection.
- Assigning a unique identification number and customer number and entering each into the sample receiving log.
- With the help of the Laboratory Manager, initiating transfer of the samples to appropriate lab sections.
- Controlling and monitoring access/storage of samples and extracts.

Final responsibility for project quality rests with Clayton's Project Manager.

2.4.5 Laboratory Technical Staff

The laboratory technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the Laboratory Operations Manager.

2.5 FIELD RESPONSIBILITIES

2.5.1 Clayton Field Project Manager

Mr. William Elwell will serve as the Clayton Field Project Manager. In his role as Field Project Manager, Mr. Elwell will be responsible for coordination of all investigation and remediation activities. He will be responsible for implementation, scheduling, and integration of the various technical disciplines that will be required during activities in the field. Specific Field Project Manager responsibilities include:

- Provision of day-to-day coordination with the Clayton Project Manager on technical issues in specific areas of expertise.
- Developing and implementing field-related work plans, assuring schedule compliance, and adhering to management-developed study requirements.
- Coordinating and managing field staff including sampling, drilling, and field laboratory staff.
- Implementing QC for technical data provided by the field staff, including field measurement data.
- Adhering to work schedules provided by the Project Manager.
- Authoring, writing, and approving text and graphics required for field efforts.
- Coordinating and overseeing technical efforts of subcontractors assisting the field team.
- Identifying problems at the field operations level, resolving difficulties in consultation with the Clayton Project Manager, implementing and documenting corrective action procedures, and providing communication between team and upper management.
- Participating in preparation of the final report.

2.5.2 Clayton Technical Field Staff

The technical field staff (team members) for this project will be drawn from Clayton's pool of corporate resources. The technical field team staff will be utilized to gather and to analyze data, and to prepare various task reports and support materials. All designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

3.0 QA OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide results that meet the objectives of the LWP. Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

3.1 PRECISION

3.1.1 Definition

Precision is a measure of the degree to which two or more measurements agree.

3.1.2 Field Precision Objectives

Field precision is assessed through collection and measurement of duplicates at a rate of one duplicate per 10 analytical samples. An estimate of the total number of duplicates for this project is found in Table 17.

3.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of relative percent differences (RPD) and relative standard deviations (RSD) for three or more replicate samples. The equations to be used for precision in this project can be found in Section 12.0 of this QAPP.

3.2 ACCURACY

3.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference value.

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed using field and trip blanks and through the adherence to all sample handling, preservation, and holding times.

3.2.3 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through analysis of matrix spikes (MS) or standard reference materials (SRM) and the determination of percent recoveries. The equation to be used for accuracy in this project can be found in Section 12.0 of this QAPP.

3.3 COMPLETENESS

3.3.1 Definition

Completeness is a measure of the amount of valid measurements obtained from all the measurements planned for each matrix and analysis in a given investigation area.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all measurements planned for each matrix and analysis in a given investigation area. The equation for completeness is presented in Section 12.0 of this QAPP. Field completeness for this project will be greater than 90 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all measurements planned for each matrix and analysis in a given investigation area. The equation for completeness is presented in Section 12.0 of this QAPP. Laboratory completeness for this project will be greater than 95 percent. Resampling will be performed if invalid groundwater results are obtained. If invalid soil results are obtained, the location of the soil sample and concentrations relative to the RAOs will be evaluated to determine if the results are critical in nature. If the results are critical, then resampling will be performed. For example, if invalid soil results are obtained from a soil sample from an inner point of a sampling grid, the results may not be considered critical and resampling may not be performed. However, if invalid soil results are obtained from the outer sample of a delineation effort, then the results would be considered more critical and resampling would be performed.

3.4 REPRESENTATIVENESS

3.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring the FSP is followed and proper sampling techniques are used.

3.4.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using proper analytical procedures, meeting sample-holding times, and analyzing and assessing field-duplicated samples. The sampling network was designed to provide data representative of site conditions. The rationale of the field sampling network is discussed in detail in Section 1.5.

3.5 COMPARABILITY

3.5.1 Definition

Comparability is an expression of the confidence with which one data set can be compared with another.

3.5.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring the FSP is followed and proper sampling techniques are used.

3.5.3 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

3.6 LEVEL OF QC EFFORT

Field blanks, trip blanks, method blanks, equipment/rinse blanks, duplicates, SRM, and MS samples will be analyzed to assess the quality of data resulting from the field sampling and analytical programs.

Field and trip blanks consisting of analyte-free water (i.e., high performance liquid-chromatography-grade water for organics' analyses and deionized water for inorganics' analyses) will be submitted to First Environmental to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site that may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Equipment/rinse blanks are analyzed to assess contamination resulting from the equipment during sampling.

Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. One MS/MSD sample will be collected for every 20 or fewer investigative samples. MS/MSD samples are designated/collected for organic analyses only.

The general level of the QC effort for the soil and groundwater investigation will be one duplicate for every 10 investigative samples, one field blank for every 10 investigative aqueous samples, and one equipment/rinse blank for every 20 investigative samples. One volatile organic analysis (VOA) trip blank consisting of distilled deionized ultra pure water will be included with each shipment of aqueous VOA samples.

4.0 SAMPLING PROCEDURES

The sampling procedures to be used in this investigation will be consistent for the purpose of this project. The FSP outlines all soil and groundwater sampling procedure information. Please refer to the following field SOPs that are included in Attachment A.

<u>SOP Description</u>	<u>SOP No.</u>
Records, Reports, Field Reporting, Documentation, and Record Retention	110
Borehole Logging and Material Classification	120
Soil Sampling and Rock Coring	200
Well Installation	210
Grouting Procedures	211
Well Development	212
Groundwater and LNAPL Level Measurements	220
Air Quality Monitoring	310
Field Measurements	320
Vapor Headspace Screening	330
Surface Water, Sediment, Sludge, and Waste Sampling	400
Groundwater Sampling	410
Equipment Decontamination	500
Sample Containers, Preservation, and Holding Times	910
Sample Classification, Storage, Packaging, and Shipment	911
Sample Control and Custody Procedures	912
Field Quality Assurance Samples	920
Control, Calibration, and Maintenance of Measurement and Test Equipment	930

5.0 CUSTODY PROCEDURES

Custody is one of several factors necessary for the admissibility of environmental data, as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if:

- The item is in actual possession of a person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in actual physical possession, but is locked up to prevent tampering.
- The item is in a designated and identified secure area.

5.1 FIELD CUSTODY PROCEDURES

Field logbooks will provide the means of recording data-collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned
- Logbook number

- Project name
- Project start date
- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, as well as field sampling or investigation team personnel and the purpose of their visit, will also be recorded in the field logbook. The information to be provided is shown in SOP No. 110.

Samples will be collected following the sampling procedures documented in the FSP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, and volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact and within the samples' respective holding times for each parameter (Table 18). The protocol for specific sample numbering, using case numbers and traffic report numbers if applicable, and other sample designations are as follows. A sample numbering system will be established to provide a unique identification for each sample to be submitted for chemical analysis, including: duplicate samples, field blanks, equipment/rinse blanks, and trip blanks. Each sample number will consist of three components as described below:

Sample Medium – The sample medium will be identified by a two- or three-digit alpha code. The alpha codes representing the sample types are as follows:

CSB	–	Clayton soil boring
MW	–	monitoring well
FB	–	field blank
GW	–	groundwater sample collected from a temporary well or borehole
TB	–	trip blank
RB	–	rinse blank
DUP	–	duplicate

Sample Location – The sample location for a particular medium will be identified by a numeric code. The monitoring wells completed in the water-bearing bedrock will have a numeric code followed by the letter (D). The monitoring wells completed in the deep water-bearing sediment will have a numeric code followed by the letter (M). The monitoring wells completed across the upper surface of the shallow water table will have a numeric code followed by the letter (S). QA/QC trip blank, field blank, and equipment rinse blank samples will have a sample number that will progress sequentially. The sample number for a duplicate sample will be identified by a unique numeric code.

Sample Interval – The sample interval for a particular soil sample and double-packer sample will be identified by the number of feet bgs the sample is collected.

Sample Modifier – The sample modifier for MS and MSD samples will be identified by a two-digit alpha code MS.

Sample Identification System Examples – A number of examples have been prepared to illustrate how the sample numbering system works. Sample number examples follow below:

CSB01/2-4	Soil sample collected at 2 to 4 feet bgs at Clayton Soil Boring CSB01.
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MW70D/80-88	Groundwater sample collected from 80 to 88 feet bgs in Bedrock Monitoring Well MW70D.
MW1115S	Groundwater sample collected from monitoring well MW1115S.
GW1812	Groundwater sample collected from a temporary monitoring well set in the borehole of Clayton soil boring CSB1812.
SS02	Water sample collected from storm sewer.
SS01MS	Water sample collected from storm sewer, MS/MSD.
RB001	Rinse blank 001.
TB001	Trip blank 001.
DUP001	Duplicate 001.

Examples of field custody documents and instructions for completion are presented in SOP No. 912.

5.2 LABORATORY CUSTODY PROCEDURES

Laboratory custody procedures for sample receiving and log-in, sample storage and numbering, tracking during sample preparation and analysis, and storage of data are described in First Environmental SOP Nos. 110, 120, and 204 (Attachment B).

5.3 FINAL EVIDENCE FILES

The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP. At the end of the project, all files will be sent to Lockformer and maintained indefinitely. USEPA may copy if desired. The Clayton Project Manager is the custodian of the

evidence file and maintains the contents of evidence files for the LWP, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secured, limited access area and under custody of the Clayton Project Manager.

The final evidence file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, airbills, etc.)

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 FIELD INSTRUMENT CALIBRATION

The field instruments will be calibrated as described in the SOPs (see Attachment A). Field instruments include a PID and a water quality/turbidity meter. As a rule, instruments will be calibrated daily prior to use and calibration checks will be performed at the middle of the day and after any questionable reading or instrument error message. For specific instructions on calibration frequency, acceptance criteria, and conditions that will require more frequent recalibration, refer to the specific SOPs for each field analysis (see Attachment A).

6.2 LABORATORY INSTRUMENT CALIBRATION

The calibrating frequency for the most impacted laboratory instruments is described in Table 14.

7.0 ANALYTICAL PROCEDURES

Groundwater and soil samples collected during field sampling activities for the LWP will be analyzed for the presence of VOCs by Method 8260B. Method 5035 preservation techniques will be employed during the collection of soil samples submitted for VOC analysis. Laboratory analysis of groundwater and soil samples will be conducted by the First Environmental Laboratories, Inc. of Naperville, Illinois (630.778.1200). The address is 1600 Shore Road, Naperville, Illinois 60563 and the responsible person is Mr. William Mottashed.

7.1 FIELD ANALYTICAL PROCEDURES

The standardization and QA information for field measurements are described in Section 6.0 of this QAPP.

7.2 LABORATORY ANALYTICAL PROCEDURES

The laboratory named above will implement the project-required SOPs. These laboratory SOPs for sample preparation, cleanup, and analysis are based on the most current version of the corresponding methods. These SOPs provide sufficient details and are specific to this investigation.

The documentation of appropriate method validation for the project target compounds is submitted in the Laboratory QA Manual, which is available upon request. It includes the criteria for acceptance, rejection, or qualification of data.

Table 15 summarizes the analyte groups of interest, the appropriate laboratory SOP numbers, and the IEPA reference method for the analytes to be evaluated in this

investigation. The laboratory SOPs to be used in this investigation are presented in Attachment B.

7.2.1 List of Project Target Compounds and Laboratory Detection Limits

A complete listing of project target compounds, project quantitation limits, and current laboratory-determined method detection limits for VOC analysis of soil and groundwater samples is presented in Table 13.

7.2.2 List of Associated QC Samples

The laboratory SOPs include a QC section that addresses the minimum QC requirements for analysis of specific analyte groups.

8.0 INTERNAL QC CHECKS

8.1 FIELD QC CHECKS

QC procedures for water quality measurements of water samples will include calibrating the instruments as described in Section 6.0 of this QAPP. Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable procedures in the FSP.

8.2 LABORATORY QC CHECKS

First Environmental has a QC program to ensure the reliability and validity of their analysis. All analytical procedures are documented in writing as SOPs, and each SOP includes a QC section that addresses the minimum QC requirements for the procedure.

For a description of the specific QC requirements of this investigation and the frequency of audit, refer to the Laboratory SOPs provided in Attachment B. The QC criteria are also included in the SOPs.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. Any samples analyzed in nonconformance with the QC criteria will be reanalyzed by the laboratory, if sufficient volume is available.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated in field activities or by the laboratory operation shall be reduced and validated prior to reporting. No data shall be disseminated by the laboratory until it has been subjected to the procedures summarized in subsections below:

9.1 DATA REDUCTION

9.1.1 Field Data Reduction Procedures

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct-read instrumentation will be employed in the field. The water quality and PID readings collected in the field will be generated from direct-read instruments following calibration per manufacturer's recommendations, as outlined in Section 6.0 of this QAPP. Such data will be written into field logbooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field staff member, and corrected in a space adjacent to the original (erroneous) entry. Later, when the results forms required for this study are being filled out, the Field Manager, identified in Section 2.0 of this QAPP, will proof the forms to determine if any transcription errors were made by the field crew.

9.1.2 Laboratory Data Reduction Procedures

For this project, the equations employed in reducing data are those in the appropriate chapter and methods of SW-846, Third Edition. Two of these equations, expressing analytical accuracy and precision, are presented in Section 12.0 of this QAPP. Such formulae make pertinent allowances for matrix type. All calculations are checked at the conclusion of each operating day. Errors are noted, corrections are made, but the original

notations are crossed out legibly. Analytical results for soil samples shall be calculated and reported on a dry-weight basis.

QC data (e.g., laboratory duplicates, surrogates, MS, and MSDs) will be compared to the method acceptance criteria. Data considered acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QA Manager for review. If approved, data is logged into the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared that will include information concerning data that fell outside acceptance limits and any other anomalous conditions encountered during sample analysis.

9.2 DATA VALIDATION

Data validation procedures shall be performed for both field and laboratory operations as described below.

9.2.1 Procedures Used to Evaluate Field Data

Procedures to evaluate field data for this project primarily include checking for transcription errors and review of field logbooks, on the part of field crewmembers. This task will be the responsibility of the Clayton Field Leader.

9.2.2 Procedures to Validate Laboratory Data

The data to be provided incorporates a rigorous level of quality control. All analytical methods strictly follow IEPA-approved protocols and quality control criteria. The data will be validated in accordance with the stated method and laboratory-specific SOPs.

SOP 110 provides the First Environmental procedures for data reduction, review, validation and reporting. The laboratory-specific SOPs are presented in Attachment B.

9.3 DATA REPORTING

Data reporting procedures shall be carried out for field and laboratory operations as indicated below:

9.3.1 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities.

9.3.2 Laboratory Data Reporting

The laboratory data reporting package for First Environmental is shown in Attachment C to this QAPP.

10.0 PERFORMANCE AND SYSTEM AUDITS AND FREQUENCY

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

10.1.1 Internal Field Audits

10.1.1.1 Internal Field Audit Responsibilities

Internal audits of field activities, including sampling and field measurements, will be conducted by the Clayton QA Officer.

10.1.1.2 Internal Field Audit Frequency

These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the site sample collection activities.

10.1.1.3 Internal Field Audit Procedures

The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, etc. Follow-up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained

throughout the remediation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

10.1.2 External Field Audits

10.1.2.1 External Field Audit Responsibilities

External field audits may be conducted by the USEPA On-Scene Coordinator or his/her designee.

10.1.2.2 External Field Audit Frequency

External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of the USEPA.

10.1.2.3 Overview of the External Field Audit Process

External field audits will be conducted according to the field activity information presented in the QAPP.

10.2 LABORATORY PERFORMANCE AND SYSTEMS AUDITS

10.2.1 Internal Laboratory Audits

10.2.1.1 Internal Laboratory Audit Responsibilities

The internal laboratory audit will be conducted by the Clayton QA Officer.

10.2.1.2 *Internal Laboratory Audit Frequency*

The internal lab system audits will be done on an annual basis, while the internal lab performance audits will be conducted on a quarterly basis.

10.2.1.3 *Internal Laboratory Audit Procedures*

The internal lab system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain of custody procedures, sample preparation and analysis, instrument operating records, etc. The performance audits will involve submitting blind QC samples to First Environmental, along with project samples, to the laboratory for analysis throughout the project. Additionally, First Environmental participates in multiple external sample Performance Evaluation (PE) programs.

The Clayton QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance.

10.2.2 External Laboratory Audits

10.2.2.1 *External Laboratory Audit Responsibilities*

An external audit will be conducted by USEPA Region V Field Services Section or its designee.

10.2.2.2 *External Laboratory Audit Frequency*

An external laboratory audit may be conducted at least once prior to the initiation of the sampling and analysis activities. These audits may or may not be announced and are at the discretion of the USEPA.

10.2.2.3 *Overview of the External Laboratory Audit Process*

External laboratory audits will include (but not be limited to) review of laboratory analytical procedures, laboratory onsite audits, and/or submission of performance evaluation samples to the laboratory for analysis.

11.0 PREVENTIVE MAINTENANCE

11.1 FIELD INSTRUMENT PREVENTIVE MAINTENANCE

The field equipment for this project includes water quality/turbidity meters and PIDs. Specific preventive maintenance procedures to be followed for field equipment are those recommended by the manufacturer. Field instruments will be checked daily before use and calibrated in the manner described in Section 6.1. Calibration checks will be documented on the field meter/calibration log sheets. Backup instruments and equipment will be available onsite or within one-day shipment to avoid delays in the field schedule.

11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

As part of their QA/QC program, the laboratory conducts a routine preventive maintenance program to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees shall regularly perform routine scheduled maintenance and repair of, or coordinate with the vendor for the repair of, all instruments. All maintenance that is performed shall be documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturers' specifications.

Table 16 of this QAPP provides the frequency for which components of key analytical instruments or equipment will be serviced.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 ACCURACY ASSESSMENT

In order to assure accuracy of analytical procedures, an environmental sample is randomly selected from each sample shipment received at the laboratory and spiked with a known amount of the analyte or analytes to be evaluated. In general, a sample spike should be included in every set of 20 samples tested on each instrument. The spike sample is then analyzed. The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines the percent recovery. Daily control charts are plotted for each commonly analyzed compound and kept on instrument-specific, matrix-specific, and analyte-specific bases. The percent recovery for a spiked sample is calculated according to the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \times 100$$

12.2 PRECISION ASSESSMENT

Spiked samples are prepared by choosing a sample at random from each sample shipment received at the laboratory, dividing the sample into equal aliquots, and then spiking each aliquot with a known amount of analyte. The duplicate samples are then included in the analytical sample set. The splitting of the sample allows the analyst to determine the precision of the preparation and analytical techniques associated with the duplicate sample. The relative percent difference (RPD) between the spike and duplicate spike are calculated and plotted. The RPD is calculated according to the following formula:

$$\text{RPD} = \frac{\text{Amount in Spike 1} - \text{Amount in Spike 2}}{0.5(\text{Amount in Spike 1} + \text{Amount in Spike 2})} \times 100$$

12.3 COMPLETENESS ASSESSMENT

Completeness is the ratio of the number of valid measurements to the total number of measurements planned for each matrix and/or analysis in a given investigation area.

Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{(\text{number of valid measurements})}{(\text{number of measurements planned})} \times 100$$

13.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-quality-control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in regular QA reports to management. Corrective action should be implemented only after approval by the Lockformer Project Manager or his designee. If immediate corrective action is required, approvals secured by telephone from the Lockformer Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Lockformer Project Manager. If the problem is analytical in nature, information on these problems will be promptly communicated to the USEPA, Quality Assurance Section. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. The Lockformer Project Manager or his designee will issue a nonconformance report for each nonconformance condition.

13.1 FIELD CORRECTIVE ACTION

Corrective action in the field can be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP, etc.) or sampling procedures and/or field analytical procedures require modification, etc. due to

unexpected conditions. In general, the field team may identify the need for corrective action. The field staff, in consultation with the Clayton Field Project Manager, will recommend a corrective action. The Field Project Manager will approve the corrective measure that will be implemented by the field team. The Clayton Field Project Manager is responsible for ensuring that the corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (i.e., additional soil borings) using existing and approved procedures in the QAPP, corrective action approved by the Clayton Field Project Manager will be documented. If corrective actions resulting in fewer samples (or analytical fractions), alternate locations, etc., cause project QA objectives not to be achieved, it will be necessary for all levels of project management, including the Lockformer Project Manager and the USEPA OSC, to concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately, if data may be adversely affected due to unapproved or improper use of approved methods. The Clayton QA Officer will identify deficiencies and recommend corrective action to the Lockformer Project Manager. Implementation of corrective actions will be performed by the Clayton Field Project Manager and technical field team. Corrective action will be documented in QA reports to the entire project management.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the USEPA OSC.

13.2 LABORATORY CORRECTIVE ACTION

Corrective action in the laboratory may occur prior to, during, and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, and/or potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the laboratory QC Coordinator to approve the implementation of corrective action. The submitted laboratory SOPs specify some conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, or automatic reinjection/reanalysis when certain QC criteria are not met, etc.

The bench chemist will identify the need for corrective action. The Laboratory Manager, in consultation with the laboratory supervisor and staff, will approve the required corrective action to be implemented by the laboratory staff. The Clayton QA Manager will ensure implementation and documentation of the corrective action. If the nonconformance causes project objectives not to be achieved, it will be necessary for all levels of project management to concur with the corrective action.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both the corrective action log (signed by analyst, section leader, and QC coordinator) and the narrative data report sent to the data validator. If corrective action does not rectify the situation, the laboratory will contact the Lockformer Project Manager.

13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

The site may identify the need for corrective action during either data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

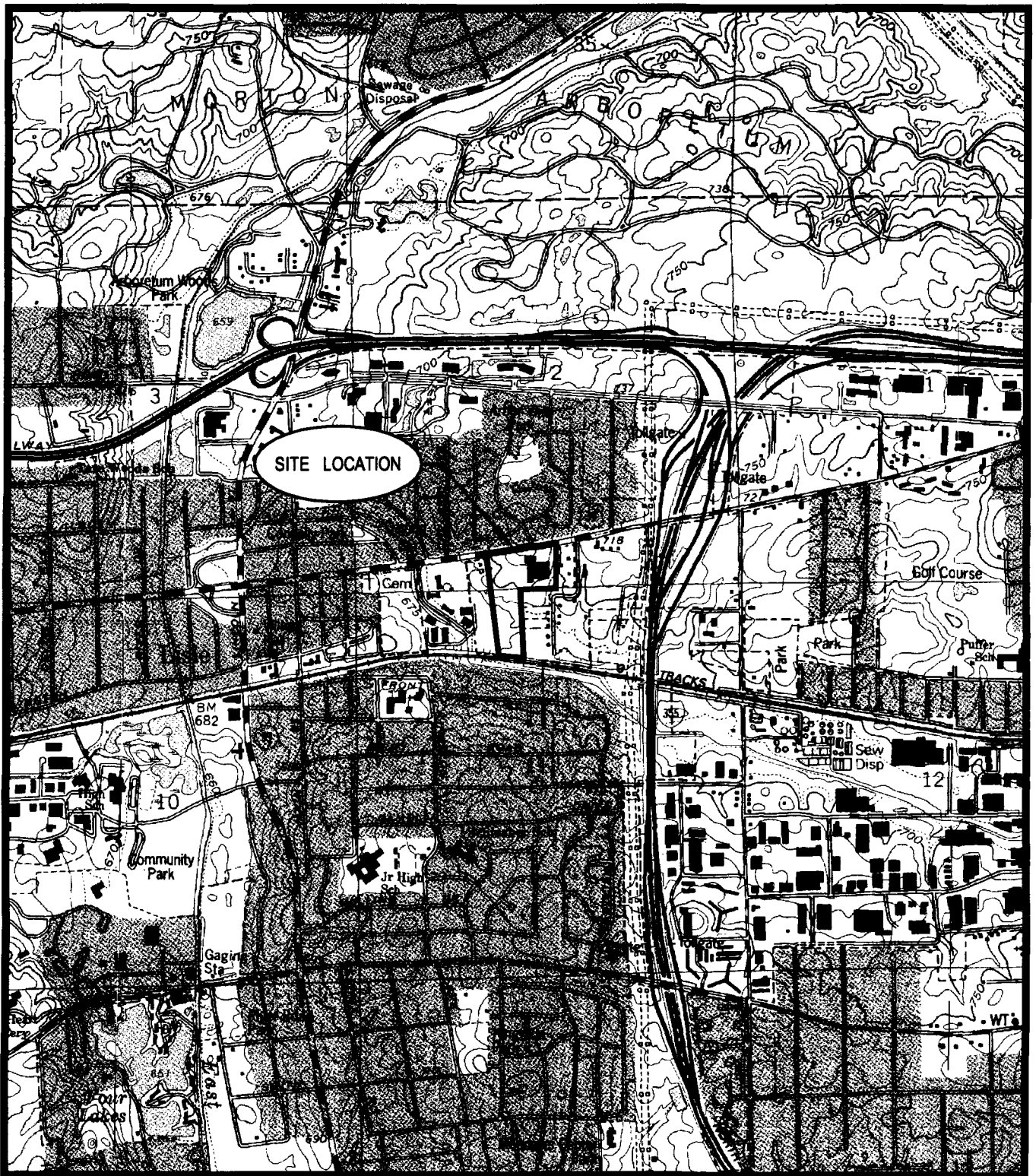
These actions are dependent upon the ability to mobilize the field team, whether the data to be collected are necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). When the Clayton QA Manager identifies a corrective action situation, the Lockformer Project Manager will be responsible for approving the implementation of corrective action, including resampling, during data assessment.

Lockformer Work Plan QAPP

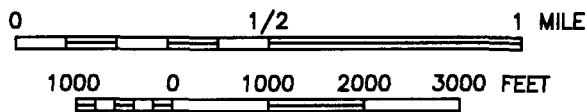
Date: 2/28/2003

65263.01- Rev.3

FIGURES



Scale 1:24000



QUADRANGLE LOCATION

FIGURE 1

SITE LOCATION MAP

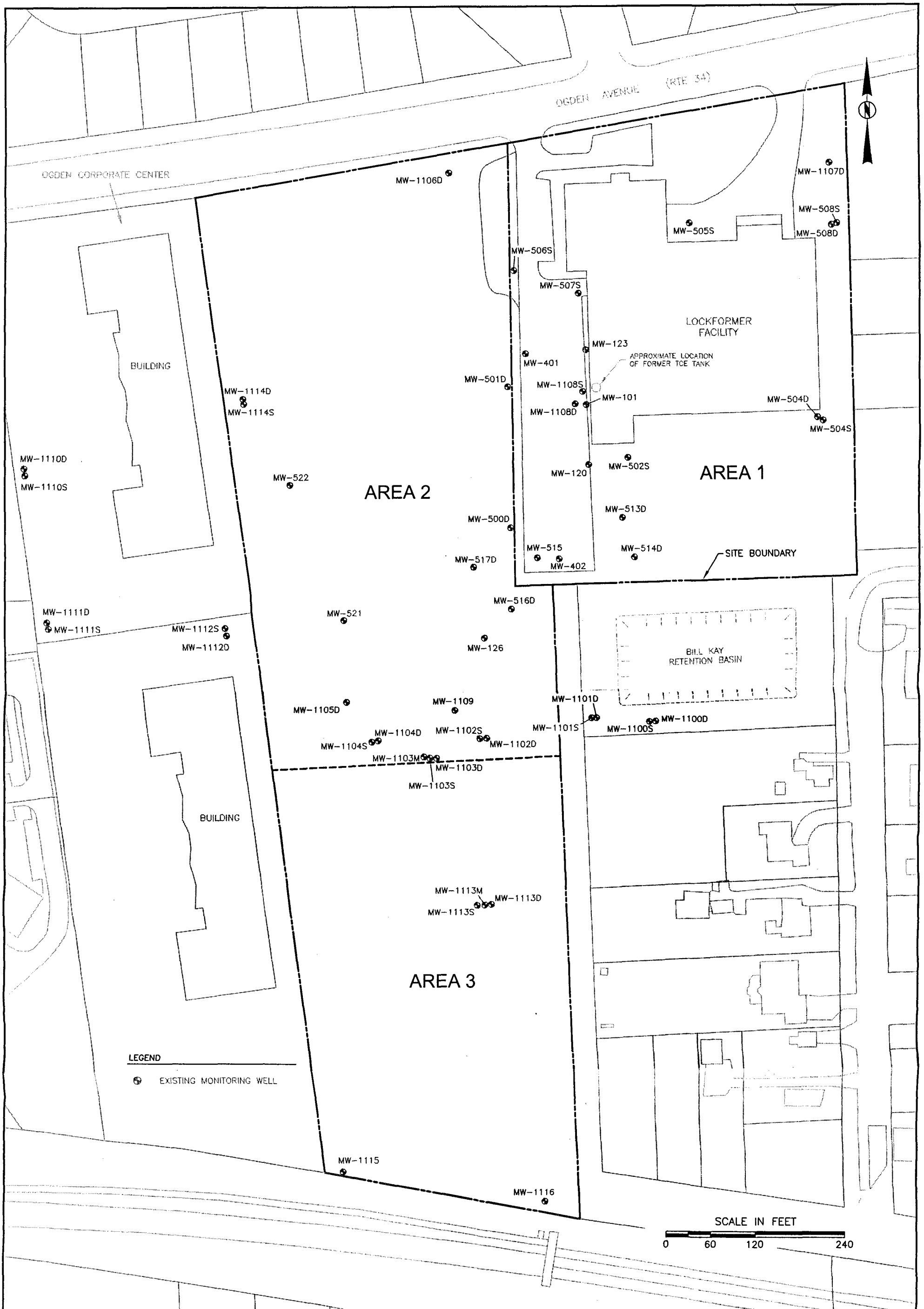
THE LOCKFORMER COMPANY

711 OGDEN AVENUE

LISLE, ILLINOIS



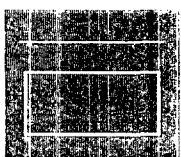
(SOURCE OF MAP IS USGS 7.5 MINUTE QUADRANGLE MAP, WHEATON, ILLINOIS - MAP EDITED 1993)





SITE TOPOGRAPHIC MAP THE LOCKFORMER COMPANY / LISLE, ILLINOIS

Legend



Surface Contours (2 Foot Interval)

Parcel Boundaries

0 240 480 720 Feet

Note:

Aerial photograph, property boundaries, and contour lines obtained from DuPage County Government.
Date of aerial photography: April 1998

Map is in Illinois State Plane, NAD 83, Feet



Project: 15-65263.01
Site_Topo_Map.MXD
Date: 04/01/02
Drawn by: SFS



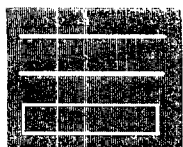
FIGURE 3



SITE TOPOGRAPHIC MAP: 1962 / 2001
THE LOCKFORMER COMPANY / LISLE, ILLINOIS



Legend



1962 Surface Contours 10 Foot Interval
 2001 Surface Contours 10 Foot Interval
 Parcel Boundaries

0 70 140 280 420
 Feet

Note: Map Sources

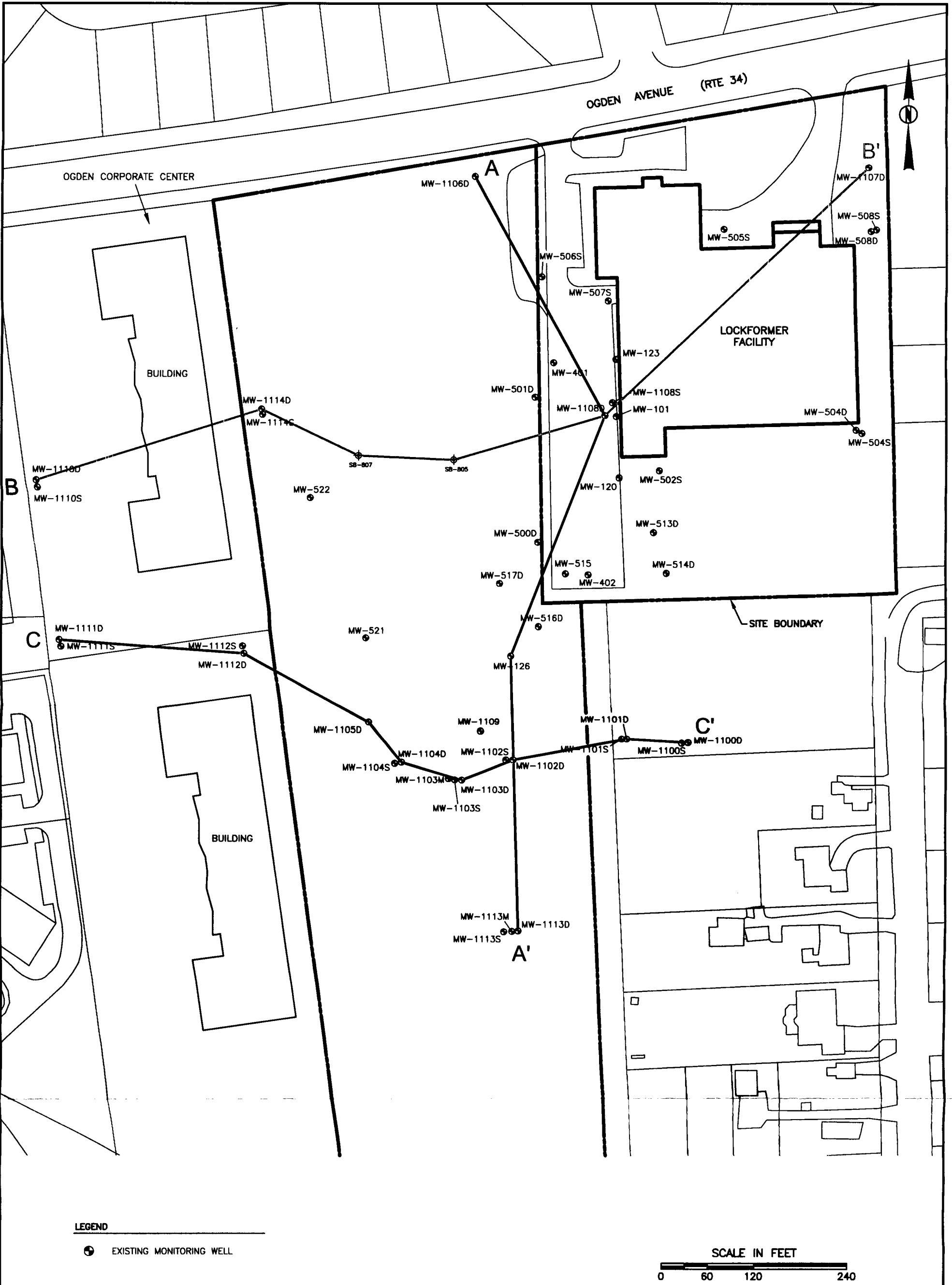
Aerial photograph, property boundaries and 2001 contours obtained from DuPage County Government, date of aerial photography: April 1998.
 1962 contour lines obtained from 1962 (Rev. 1972 / 1980) USGS Quadrangle - Wheaton, IL

Map is in Illinois State Plane, NAD 83, Feet

Project: 15-65263.01
SiteTopoMap_R.MXD
Date: 04/01/02
Drawn by: SFS



FIGURE 3A



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DATE	04-05-02
SCALE	AS SHOWN
CAD NO.	65263010G
PRJ NO.	65263.01

CROSS SECTION REFERENCE MAP

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



Clayton

GROUP SERVICES

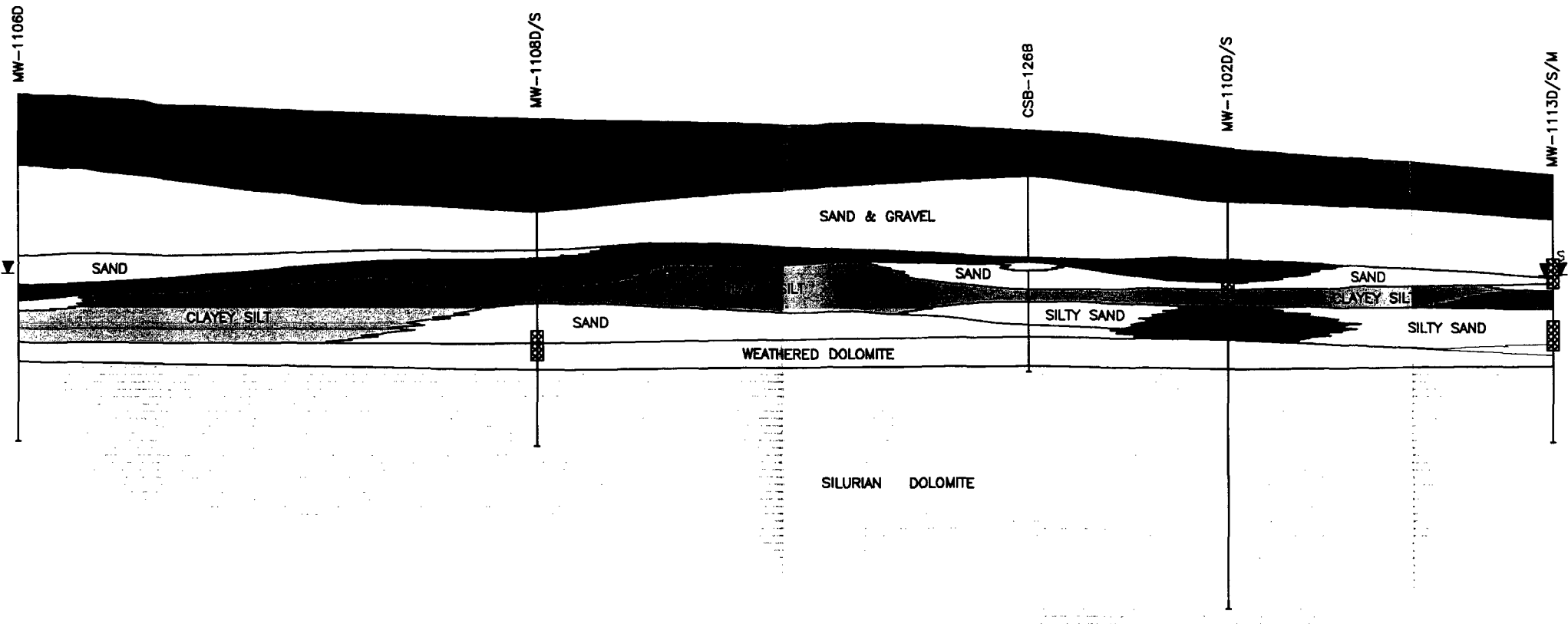
3140 FINLEY ROAD, DOWNERS GROVE, IL 60515

FIGURE

4

NORTH
A

720
700
680
660
640
620
600
580
560
540



SOUTH
A'

720
700
680
660
640
620
600
580
560
540

LEGEND

- SILTY CLAY
- CLAYEY SILT
- CLAY
- CLAYEY SAND & GRAVEL
- SAND & GRAVEL
- SAND
- SILTY SAND
- SILT
- WEATHERED DOLOMITE
- DOLOMITE

- WATER LEVEL MEASURED ON OCTOBER 17, 2001
- BEDROCK MEASUREMENT ON LEFT
- GLACIAL DRIFT MEASUREMENT ON RIGHT
- SCREEN INTERVAL

HORIZONTAL
SCALE IN FEET
0 50 100 200
VERTICAL EXAGGERATION = 2X

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DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010H
PRJ NO.	65263.01

CROSS SECTION A - A'
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

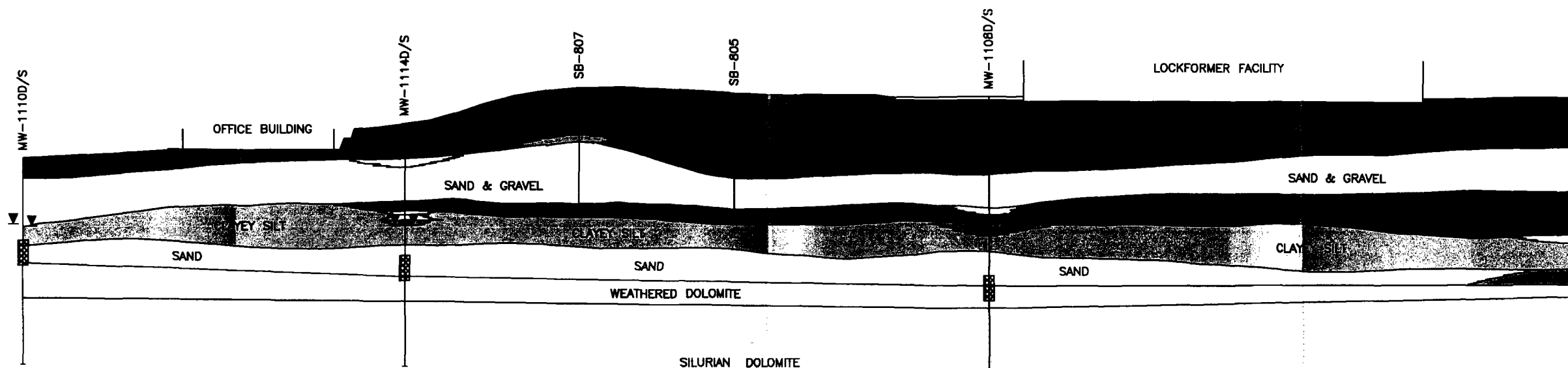
5

WEST
B

720
700
680
660
640
620
600
580

EAST
B'

720
700
680
660
640
620
600
580



- SILTY CLAY
- CLAYEY SILT
- CLAY
- CLAYEY SAND & GRAVEL
- SAND & GRAVEL
- SAND
- SILTY SAND
- SILT
- WEATHERED DOLOMITE
- DOLOMITE

LEGEND

- WATER LEVEL MEASURED ON OCTOBER 17, 2001
- BEDROCK MEASUREMENT ON LEFT
- GLACIAL DRIFT MEASUREMENT ON RIGHT

- SCREEN INTERVAL

HORIZONTAL
SCALE IN FEET
0 50 100 200
VERTICAL EXAGGERATION = 2X

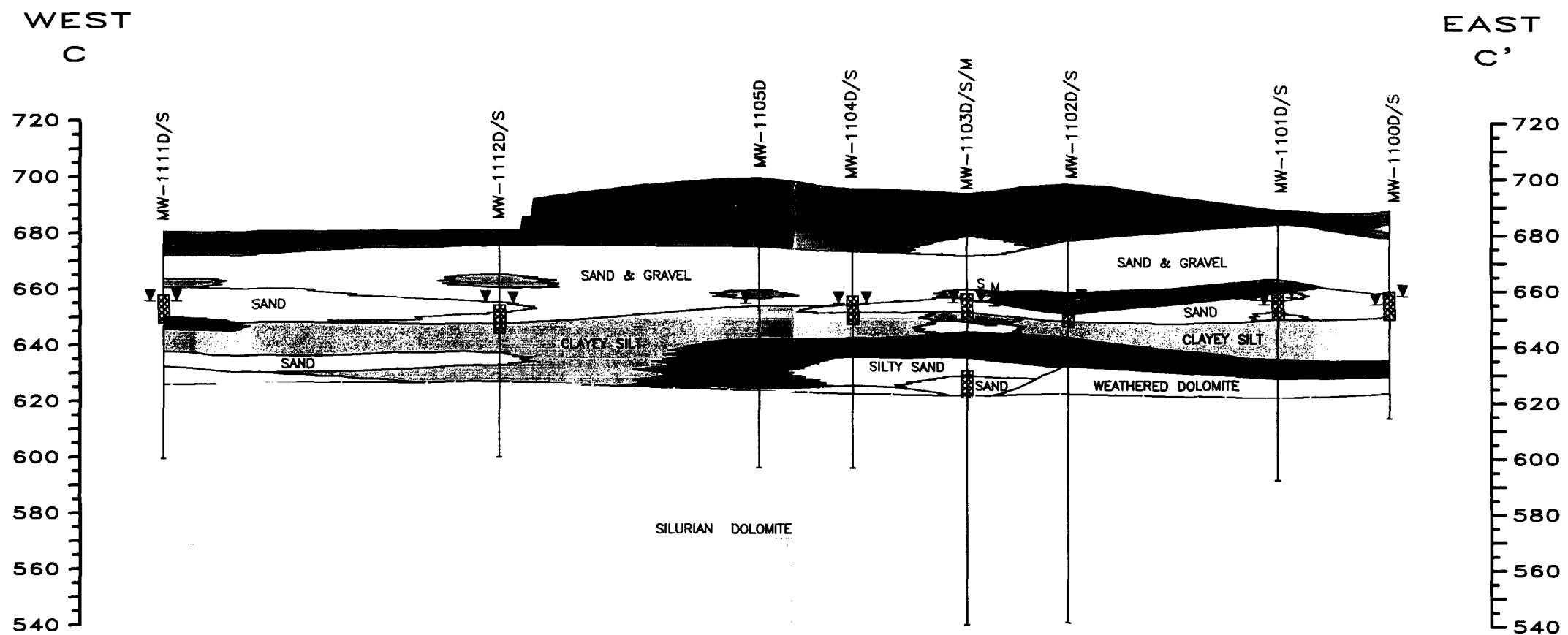
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CAD NO. 65263010i
PRJ NO. 65263.01

CROSS SECTION B - B'
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

6



- SILTY CLAY
- CLAYEY SILT
- CLAY
- CLAYEY SAND & GRAVEL
- SAND & GRAVEL
- SAND
- SILTY SAND
- SILT
- WEATHERED DOLOMITE
- DOLOMITE

LEGEND

- WATER LEVEL MEASURED ON OCTOBER 17, 2001
- BEDROCK MEASUREMENT ON LEFT
- GLACIAL DRIFT MEASUREMENT ON RIGHT

- SCREEN INTERVAL

HORIZONTAL
SCALE IN FEET
0 50 100 200
VERTICAL EXAGGERATION = 2X

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PRJ NO.	65263.01

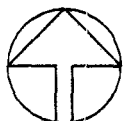
CROSS SECTION C - C'

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

7



NORTH

FACTORY PLAN

SCALE 1/16" = 1'-0"

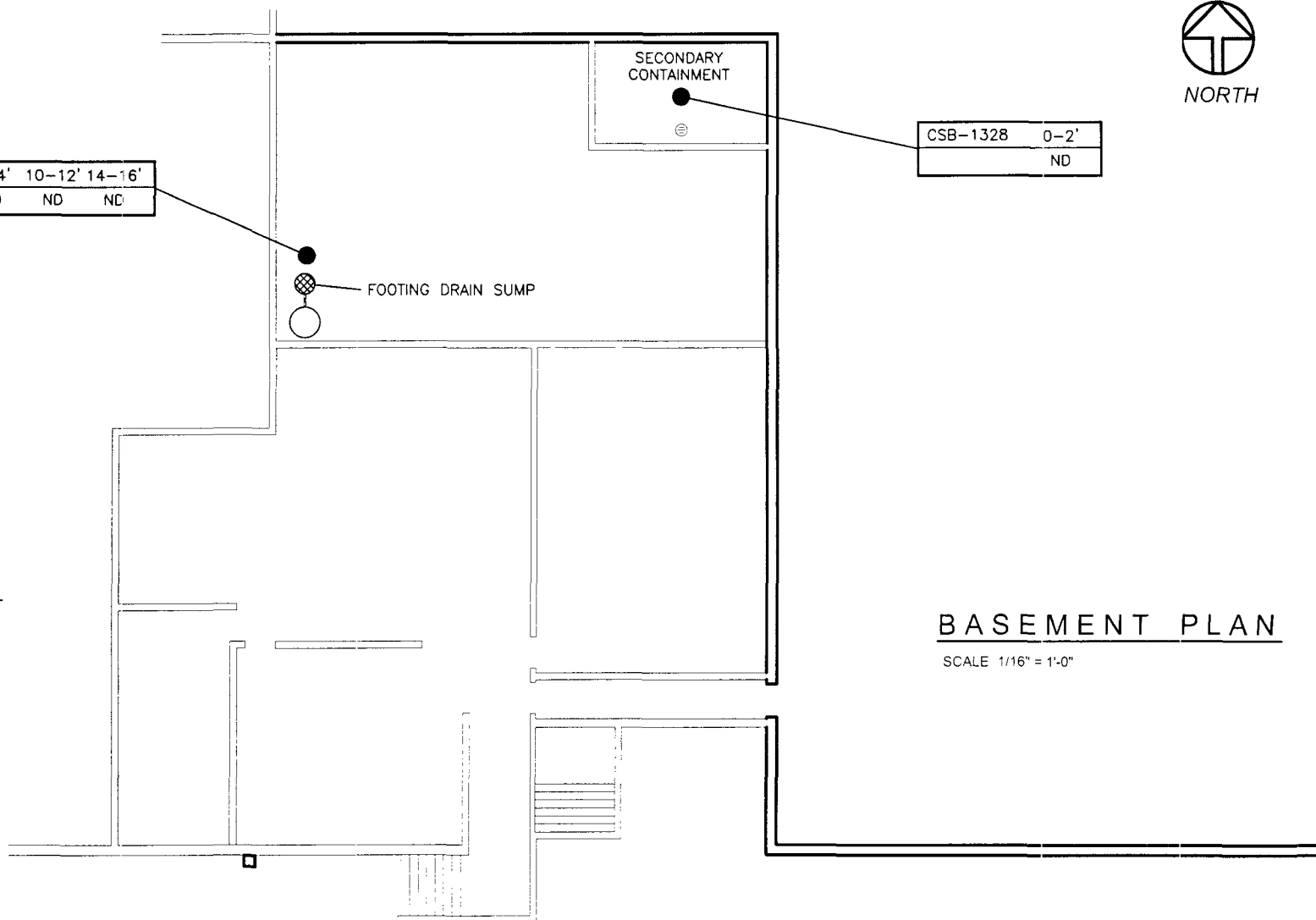
NOTE: THIS DRAWING IS A REDRAWN DUPLICATE OF THE BADLY
DAMAGED ONLY EXISTING AS-BUILT OF DRAWING P-3
DWG. MARCH 20, 2001

INVESTIGATION RESULTS AROUND THE FORMER TCE
DEGREASER, SANITARY STORM SEWER LINES AND ASSOCIATED
FLOOR DRAINS, AND THE SOUTH EXTERIOR DOOR

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

FIGURE

8



NORTH

LEGEND

● BORING LOCATION

BASEMENT PLAN

SCALE 1/16" = 1'-0"

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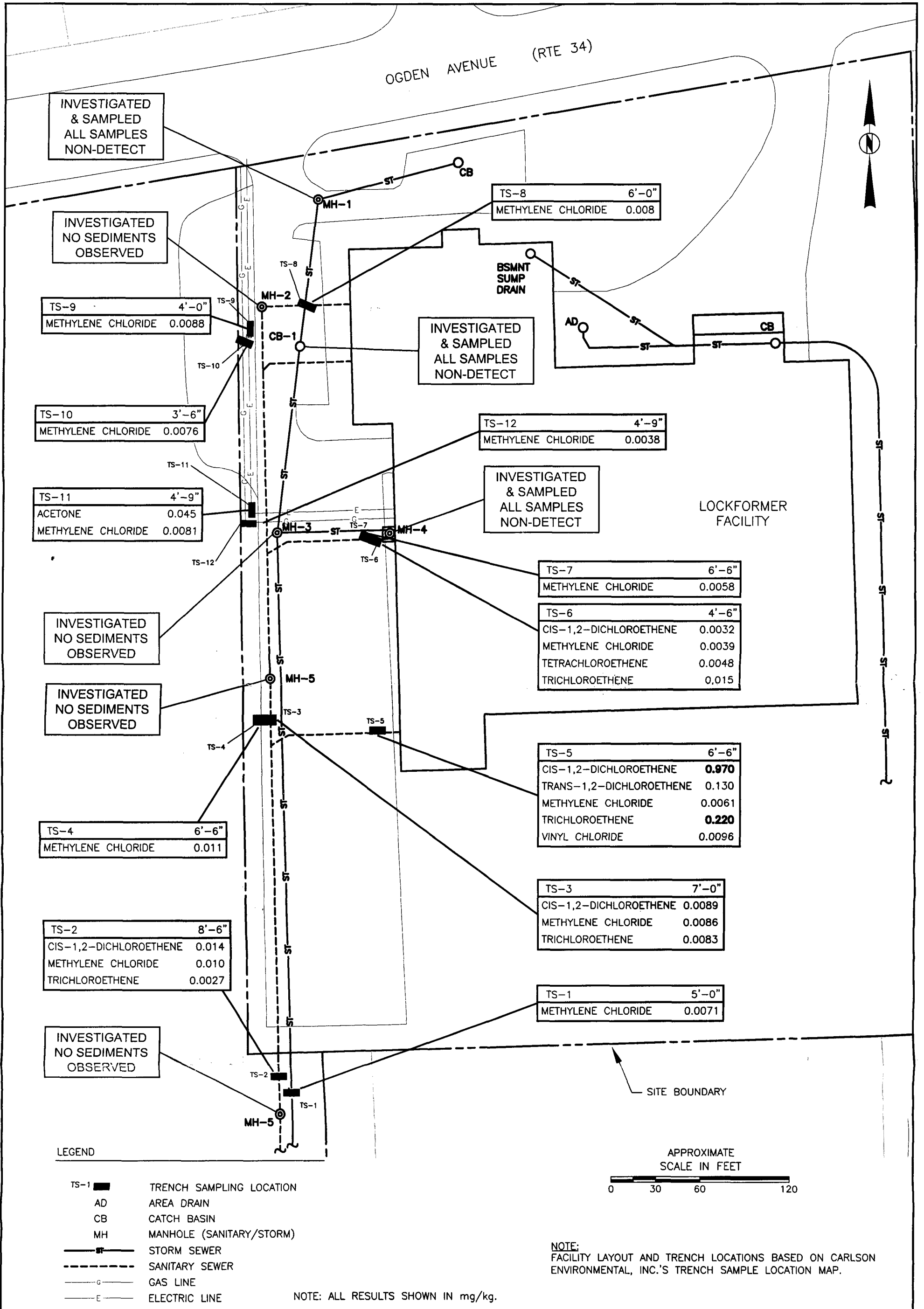
BUILDING BASEMENT
SUMP SAMPLING RESULTS

THE LOCKFORMER COMPANY
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FIGURE

9



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STORM AND SANITARY SEWER SAMPLING LOCATIONS AND RESULTS

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



3140 FINLEY ROAD, DOWNERS GROVE, IL 60515

FIGURE

10

ELEVATION=720.38

SITE BENCHMARK:

IRON PIPE CONTROL POINT NUMBER 9003 SET AT THE NORTH
CENTER POINT OF THE LOCKFORMER PROPERTY ALONG OGDEN
AVENUE.

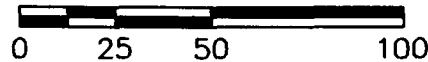
ELEVATION= 715.14

MOST RECENT TOPOGRAPHIC FIELD WORK COMPLETED ON NOVEMBER 30, 2001

STORM MH 10
681.55 TOP RIM
668.59 INVERT NORTH
668.59 INVERT WEST

SAN MH 1
680.95 TOP RIM
661.13 INVERT EAST
661.13 INVERT SOUTHWEST

SCALE IN FEET



TOP RIM
INVERT NORTHEAST
INVERT WEST

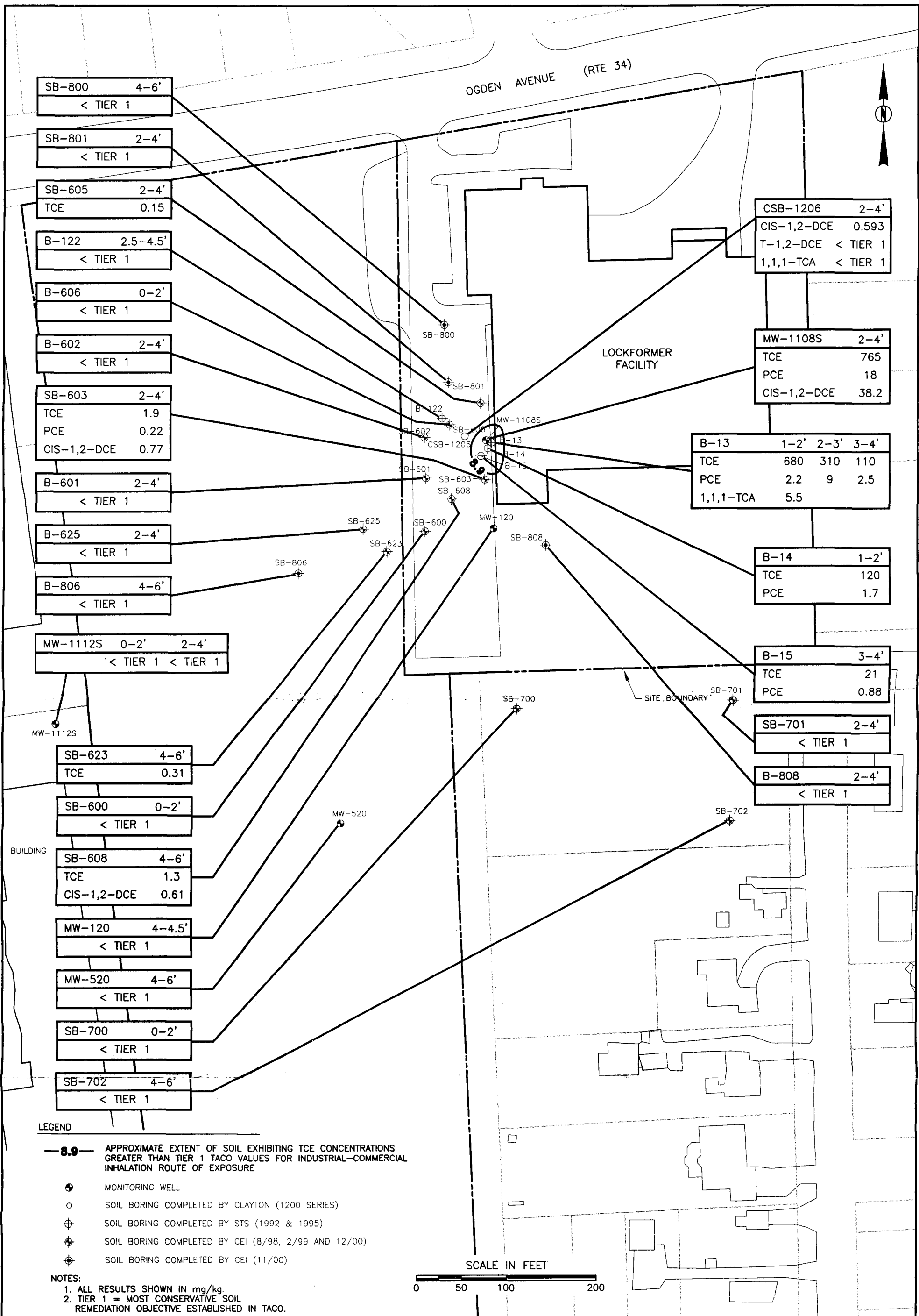
MAP CREATED BY MANHARD CONSULTING LTD. FOR CLAYTON GROUP SERVICES.

STORM AND SANITARY SEWER

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

FIGURE

1 1



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DATE 6-21-02
SCALE AS SHOWN
CAD NO. 65263010o-A
PRJ NO. 65263.01

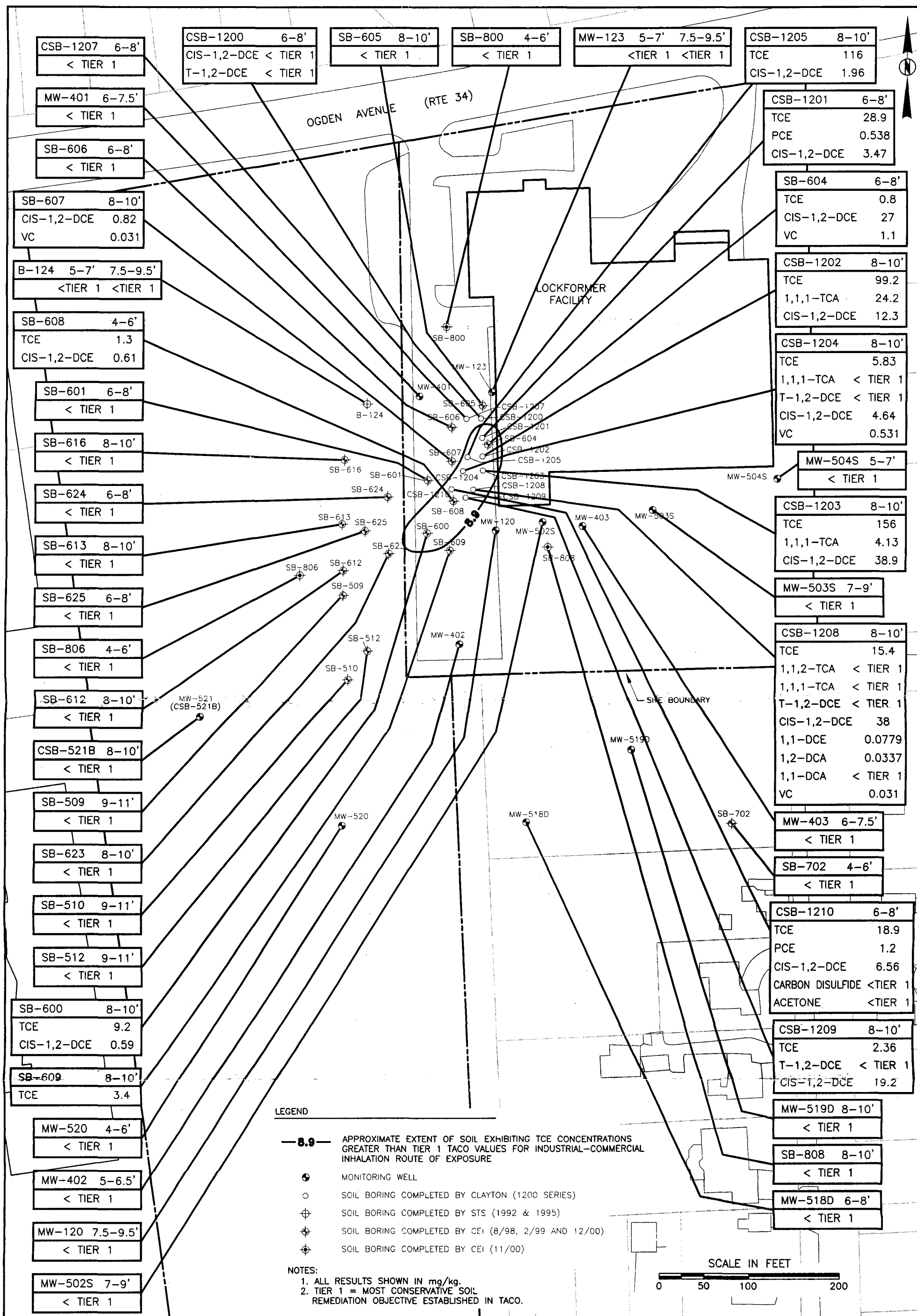
SOIL ANALYTICAL RESULTS IN THE FILL/TILL
AT THE 0-5' DEPTH INTERVAL

LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

Clayton
GROUP SERVICES

FIGURE

12A



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SCALE AS SHOWN
CAD NO. 652630100-B
PRJ NO. 65263.01

SOIL ANALYTICAL RESULTS IN THE FILL/TILL
AT THE 5-10' DEPTH INTERVAL

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

Clayton
GROUP SERVICES

FIGURE

12B

IG TCE CONCENTRATIONS
R INDUSTRIAL-COMMERCIAL

200 SERIES)

& 1995)

2/99 AND 12/00)

SB-600 14-16'

< TIER 1

SB-610 10-12'

TCE 5.3

CIS-1,2-DCE 0.91

SB-611 12-14'

TCE 2.3

CIS-1,2-DCE 0.54

MW-402 14-15'

< TIER 1

SB-623 12-14'

< TIER 1

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RJ NO. 65263.01

SOIL ANALYTICAL RESULTS IN THE FILL/TILL
AT THE 10-15' DEPTH INTERVAL

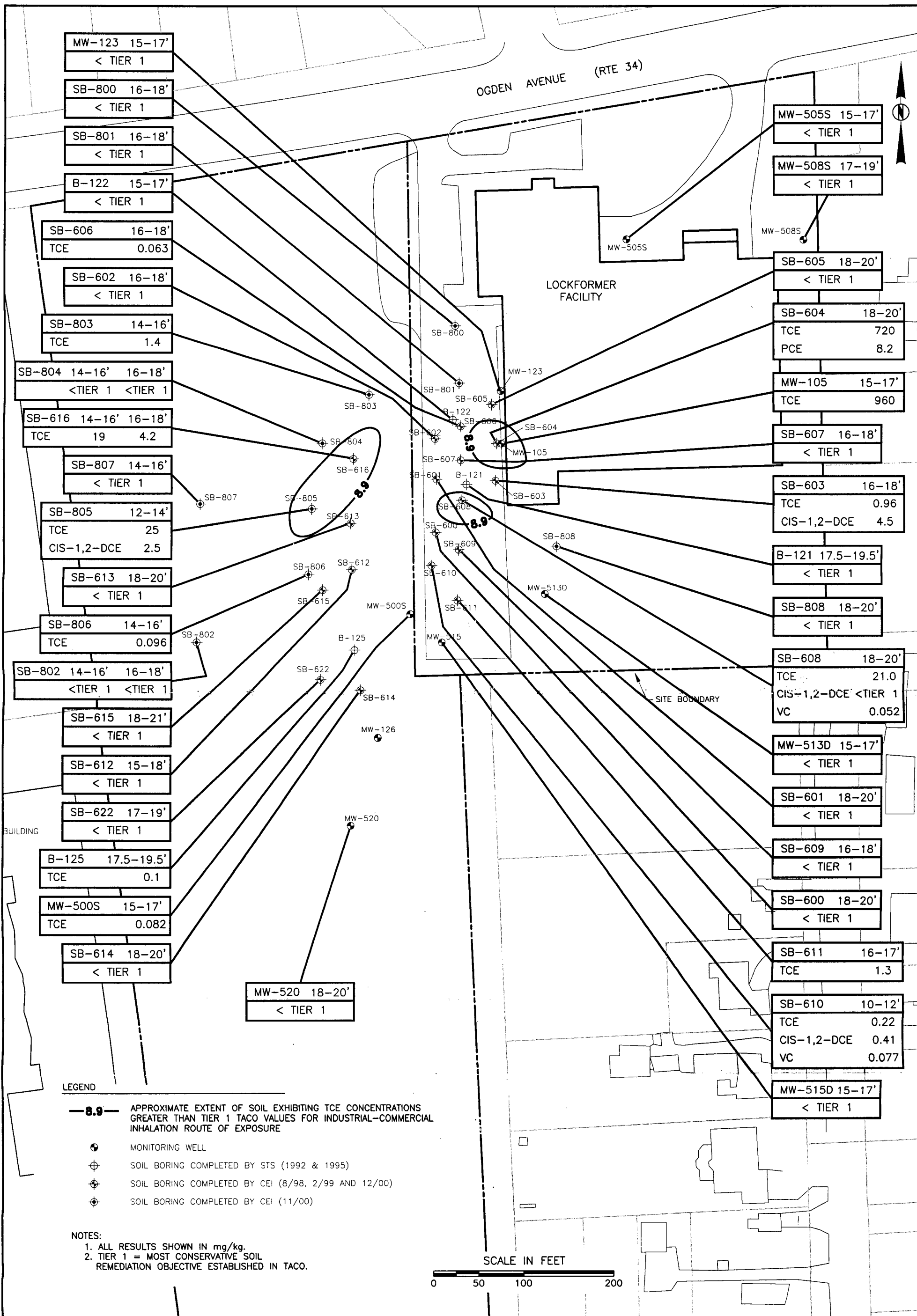
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



Clayton
GROUP SERVICES

FIGURE

12C



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SCALE	AS SHOWN
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PRJ NO.	65263.01

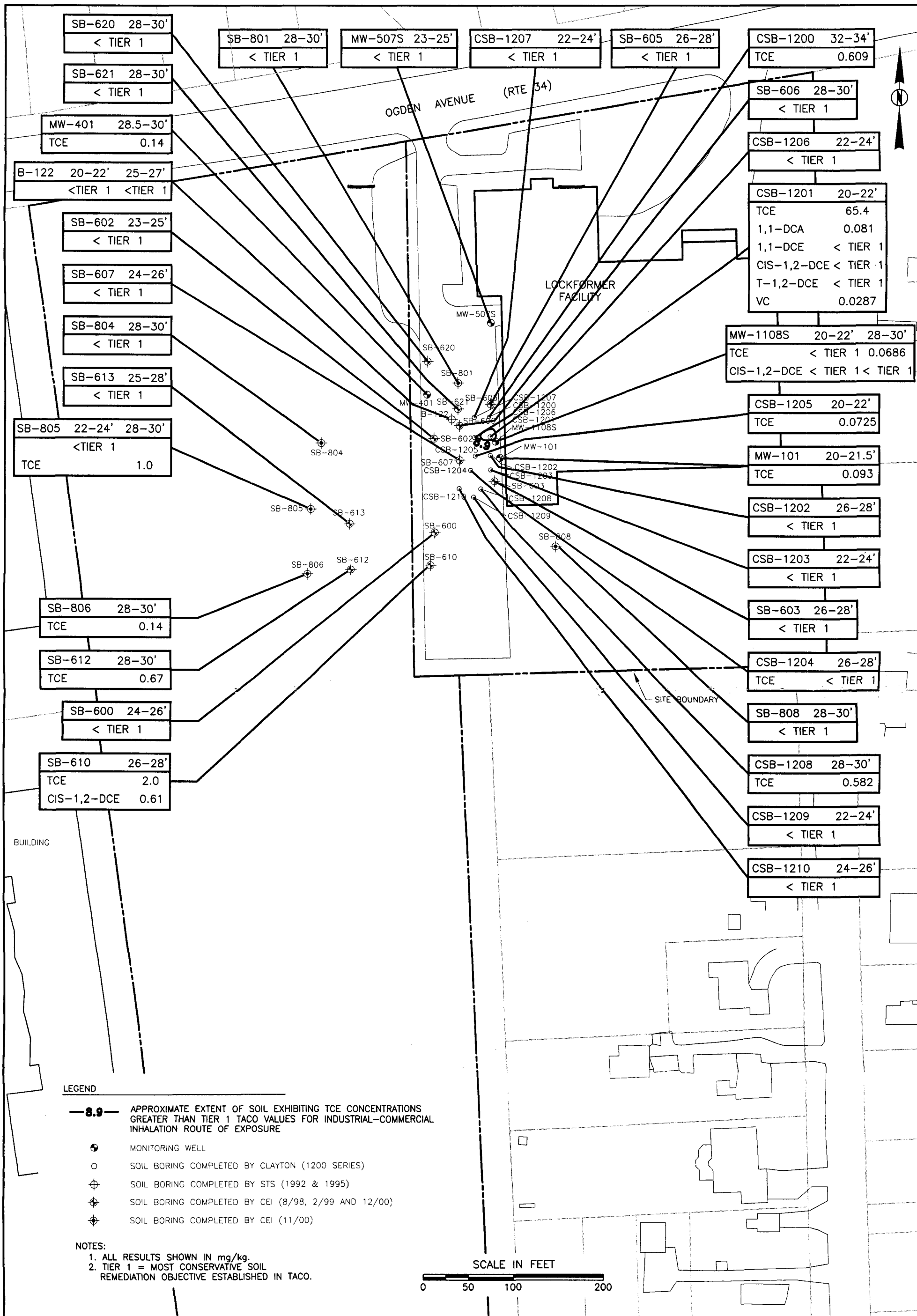
SOIL ANALYTICAL RESULTS IN THE FILL/TILL
AT THE 15-20' DEPTH INTERVAL

LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

12D



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DATE	6-21-02
SCALE	AS SHOWN
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PRJ NO.	65263.01

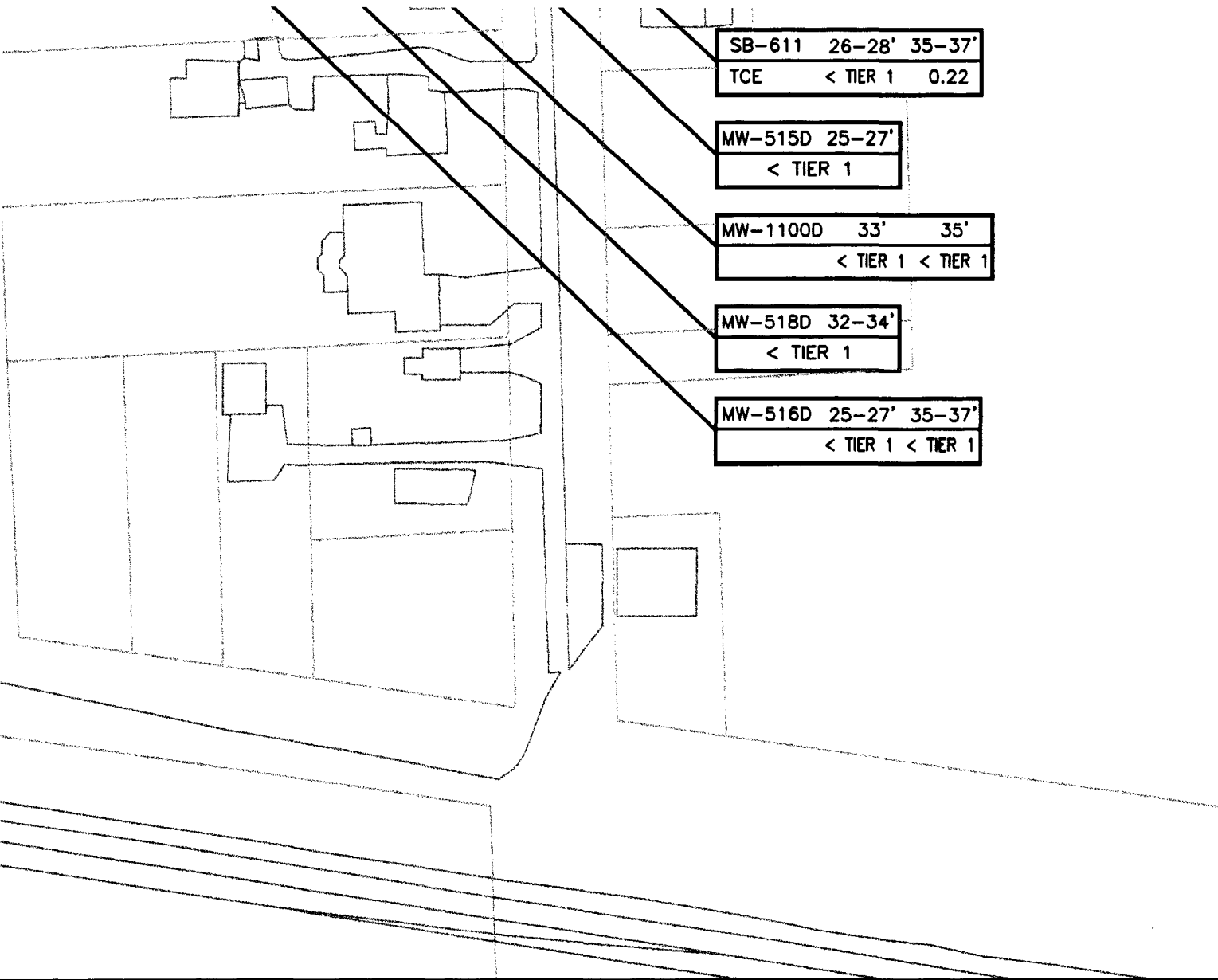
SOIL ANALYTICAL RESULTS IN THE FILL/TILL
AT THE 20-34' DEPTH INTERVAL

LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

12E



CHECK BY	
DRAWN BY BCP	
DATE	6-21-02
SCALE	AS SHOWN
AD NO.	652630100-F
RJ NO.	65263.01

SOIL ANALYTICAL RESULTS
FOR THE MASS WASTE UNIT

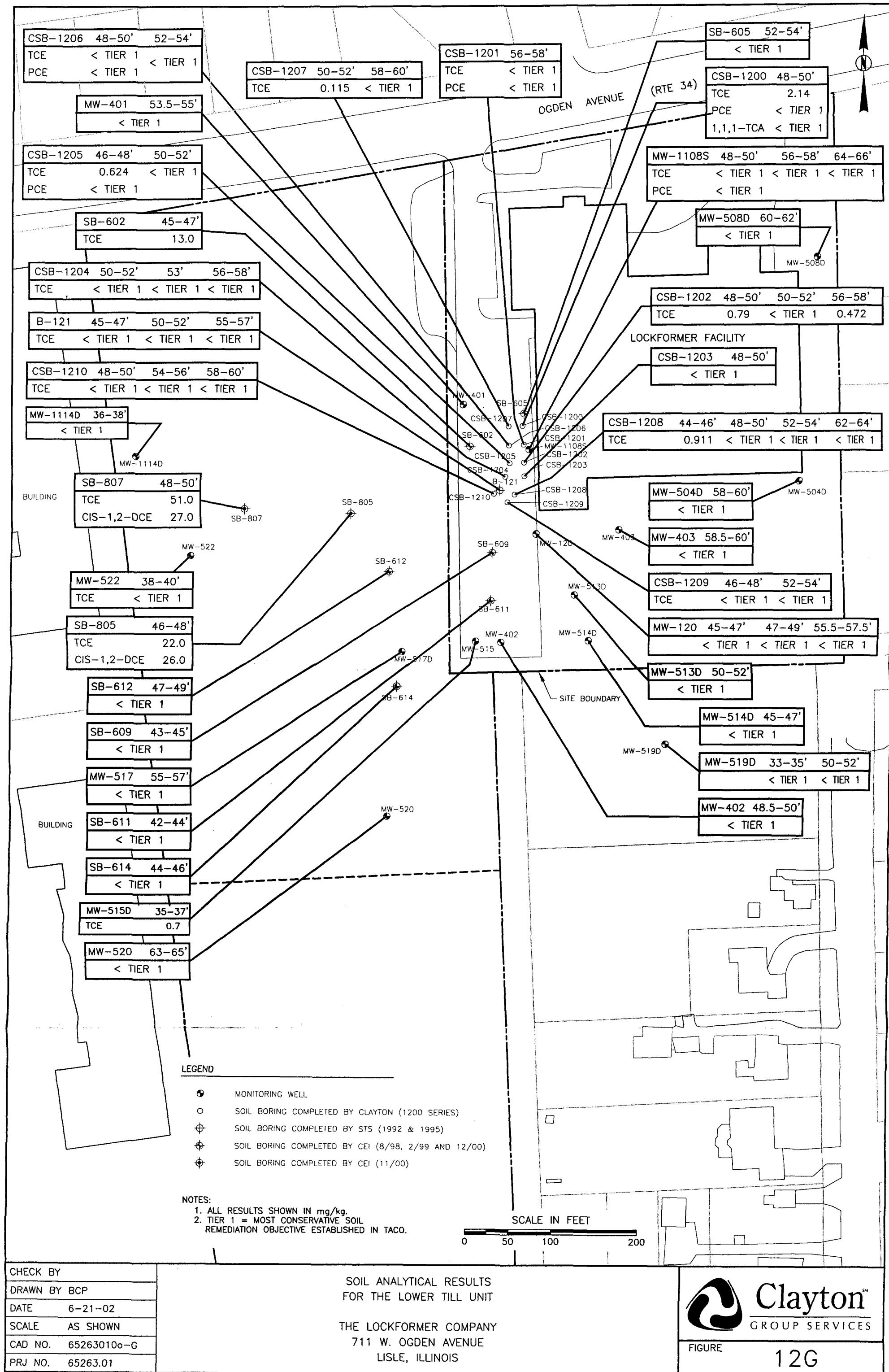
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

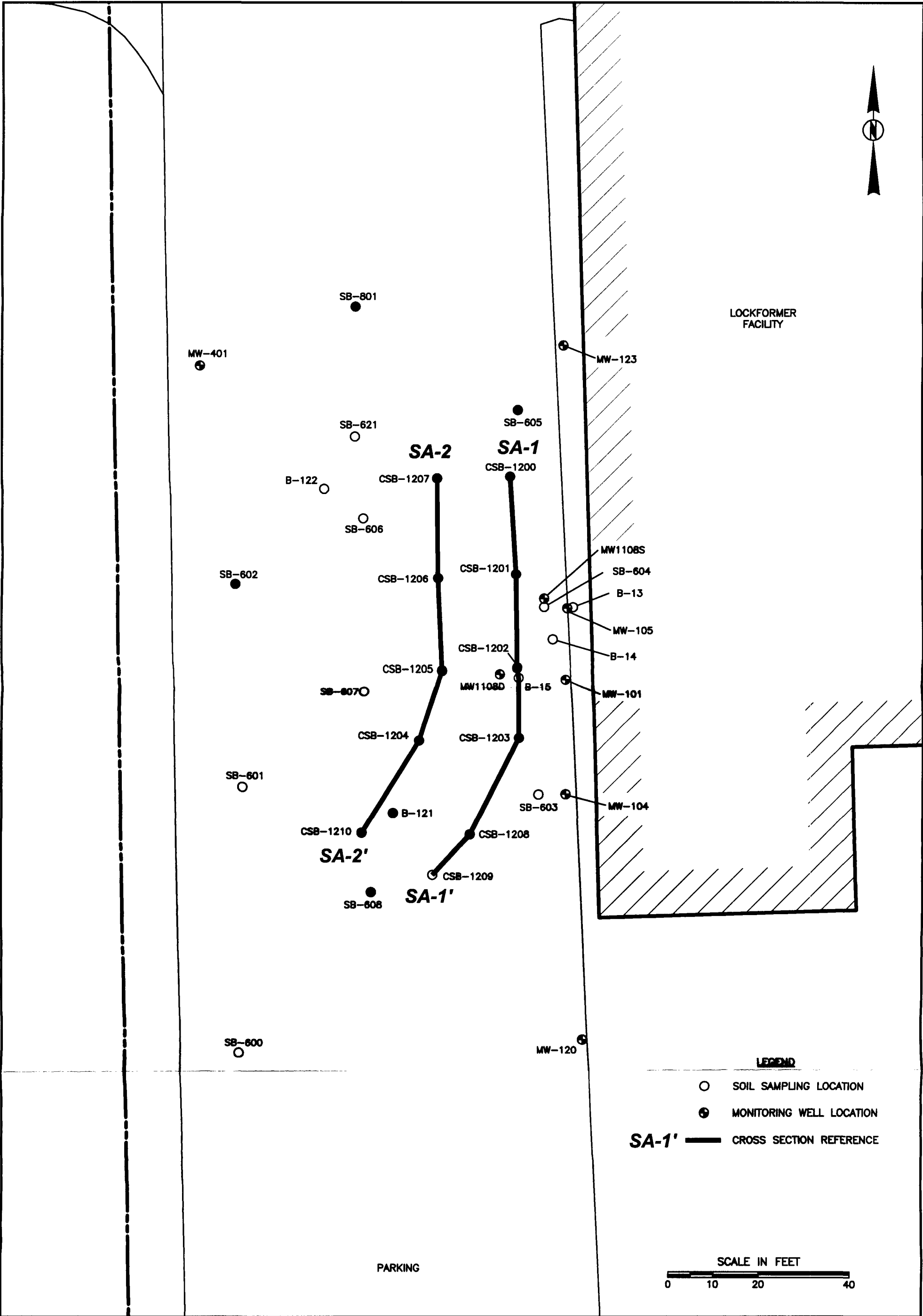


Clayton
GROUP SERVICES

FIGURE

12F



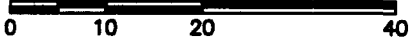


LEGEND

- SOIL SAMPLING LOCATION
- ⊕ MONITORING WELL LOCATION

SA-1' — CROSS SECTION REFERENCE

SCALE IN FEET

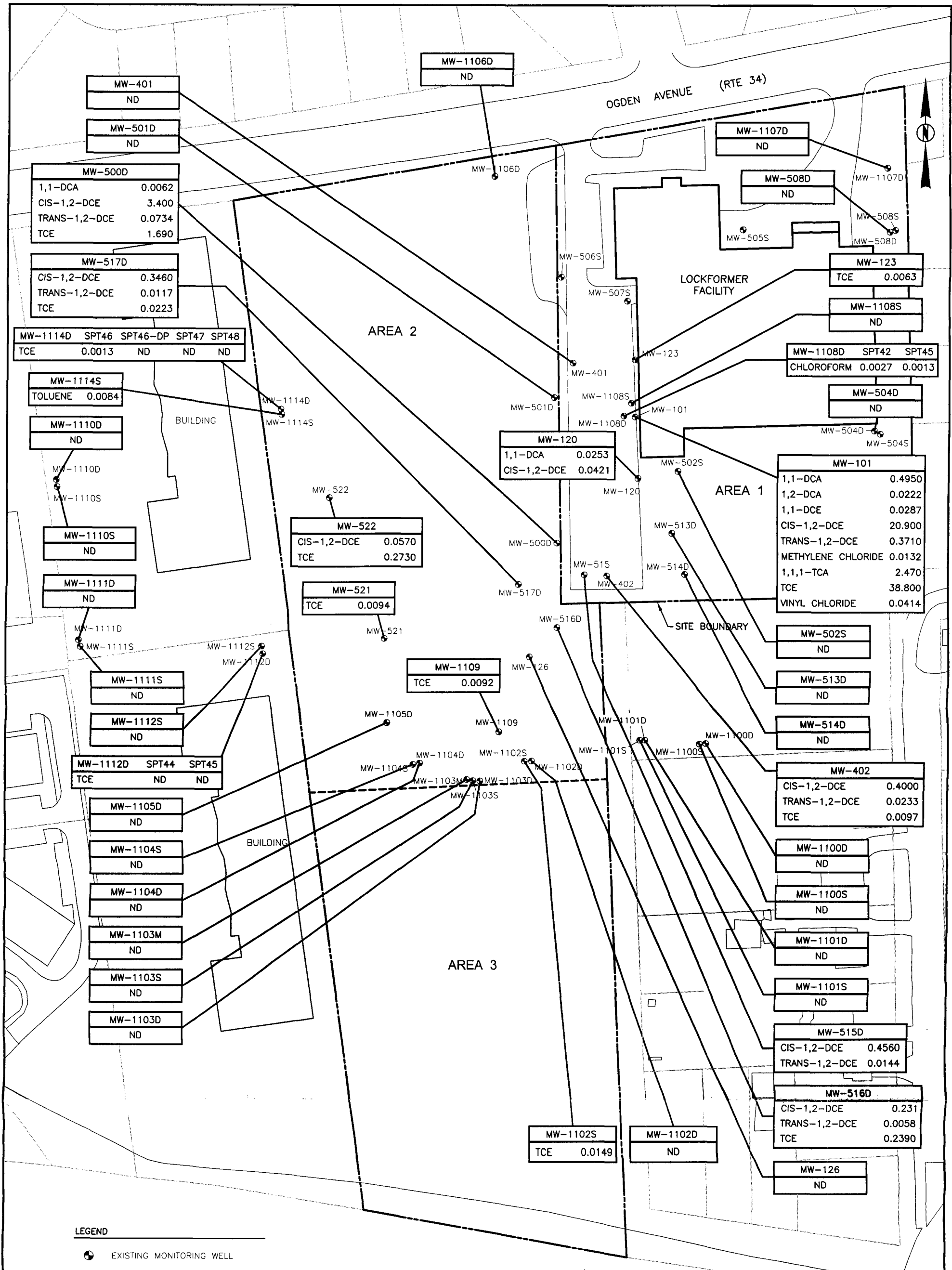


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DRAWN BY	BCP
DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010P
PRJ NO.	65263.01

CROSS SECTION LOCATIONS FOR
SA-1/SA-1' AND SA-2/SA-2'

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS


 **Clayton**
GROUP SERVICES
3140 FINLEY ROAD, DOWNERS GROVE, IL 60515
FIGURE 13



CHECK BY	
DRAWN BY	BCP
DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010S
PRJ NO.	65263.01

MOST RECENT GROUNDWATER SAMPLING RESULTS
FROM MONITORING WELLS IN AREAS 1 AND 2

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

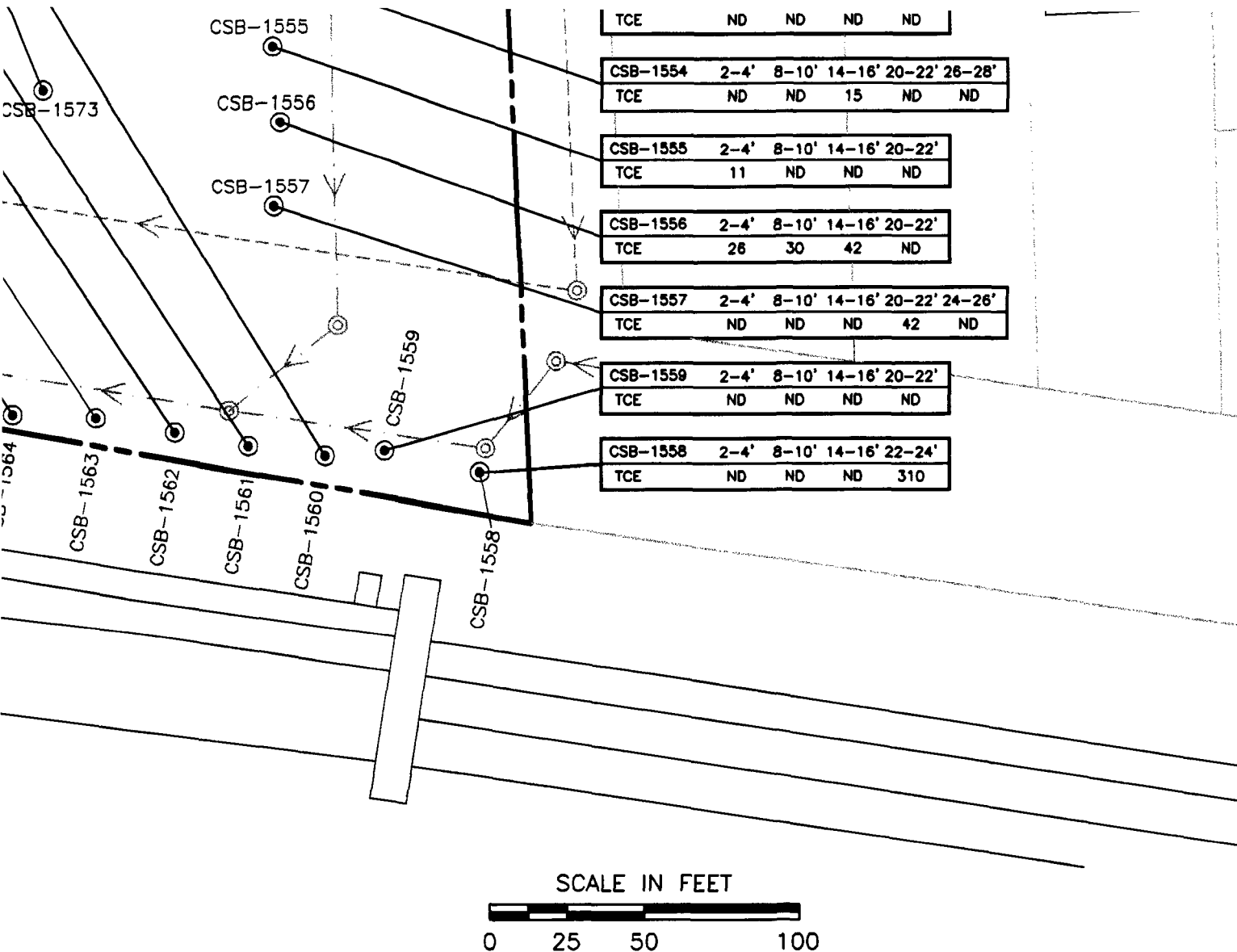


Clayton
GROUP SERVICES

3140 FINLEY ROAD, DOWNERS GROVE, IL 60515

FIGURE

16



CHECK BY	
DRAWN BY	BCP
DATE	4-5-02
SCALE	AS SHOWN
AD NO.	65263010T
PRJ NO.	65263.01

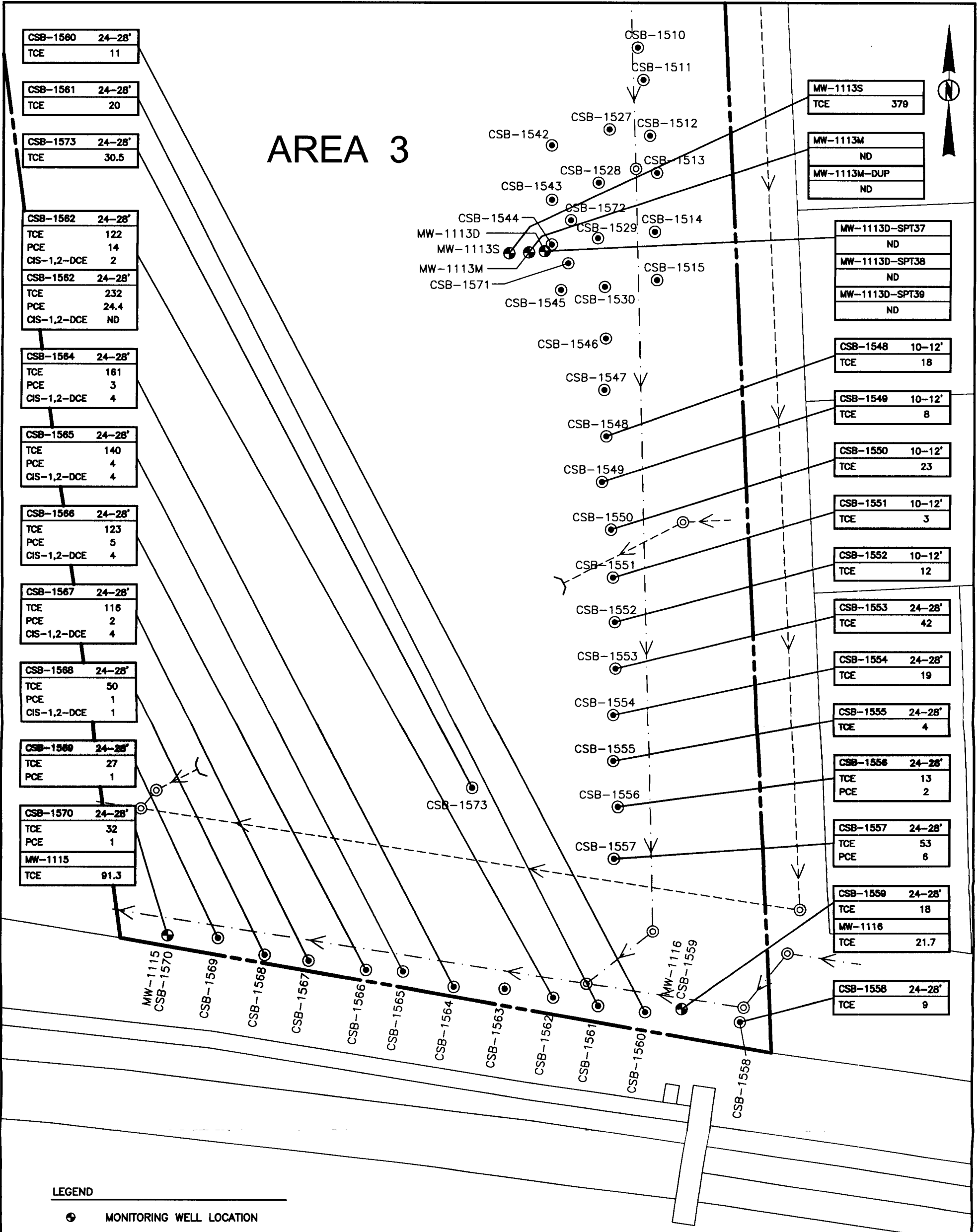
SUMMARY OF RESULTS FROM THE 1500-SERIES BORINGS IN AREA 3

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

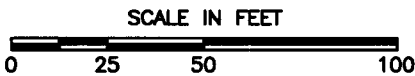
17



LEGEND	
	MONITORING WELL LOCATION
	SOIL BORING LOCATION
	SANITARY SEWER LINE
	STORM SEWER LINE

NOTE: GROUNDWATER DEPTHS ARE APPROXIMATE.
ALL RESULTS SHOWN IN ug/L

FIELD GC
FIRST ENV. LAB, INC. (FIXED LAB RESULTS)



CHECK BY	
DRAWN BY BCP	
DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010U
PRJ NO.	65263.01

SUMMARY OF THE GROUNDWATER SAMPLING RESULTS FROM MONITORING
WELLS AND THE 1500-SERIES BORINGS IN AREA 3

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

ClaytonSM
GROUP SERVICES

FIGURE
18

AREA 2

LOCKFORMER
FACILITY

AREA 1

PARKING

SITE BOUNDARY

SCALE IN FEET

0 25 50 100

LEGEND

- PROPOSED GRID BORING LOCATION
- ⊕ MONITORING WELL
- SOIL BORING COMPLETED BY CLAYTON (1200 SERIES)
- ⊕ SOIL BORING COMPLETED BY STS (1992 & 1995)
- ⊕ SOIL BORING OF GEOPROBE COMPLETED BY STS (1997)
- ⊕ SOIL BORING COMPLETED BY CEI (8/98, 2/99 AND 12/00)
- ⊕ SOIL BORING COMPLETED BY CEI (11/00)
- 8.9 — ESTIMATED LIMIT OF COHESIVE UPPER TILL CONTAINING > 8.9 mg/kg TCE(RAO).

NOTE:
RED SYMBOLS IDENTIFY THE LOCATION OF SAMPLES FROM THE
500-1200 SERIES BORINGS WHERE INDIVIDUAL VOCS EXCEEDED THE RAO'S.

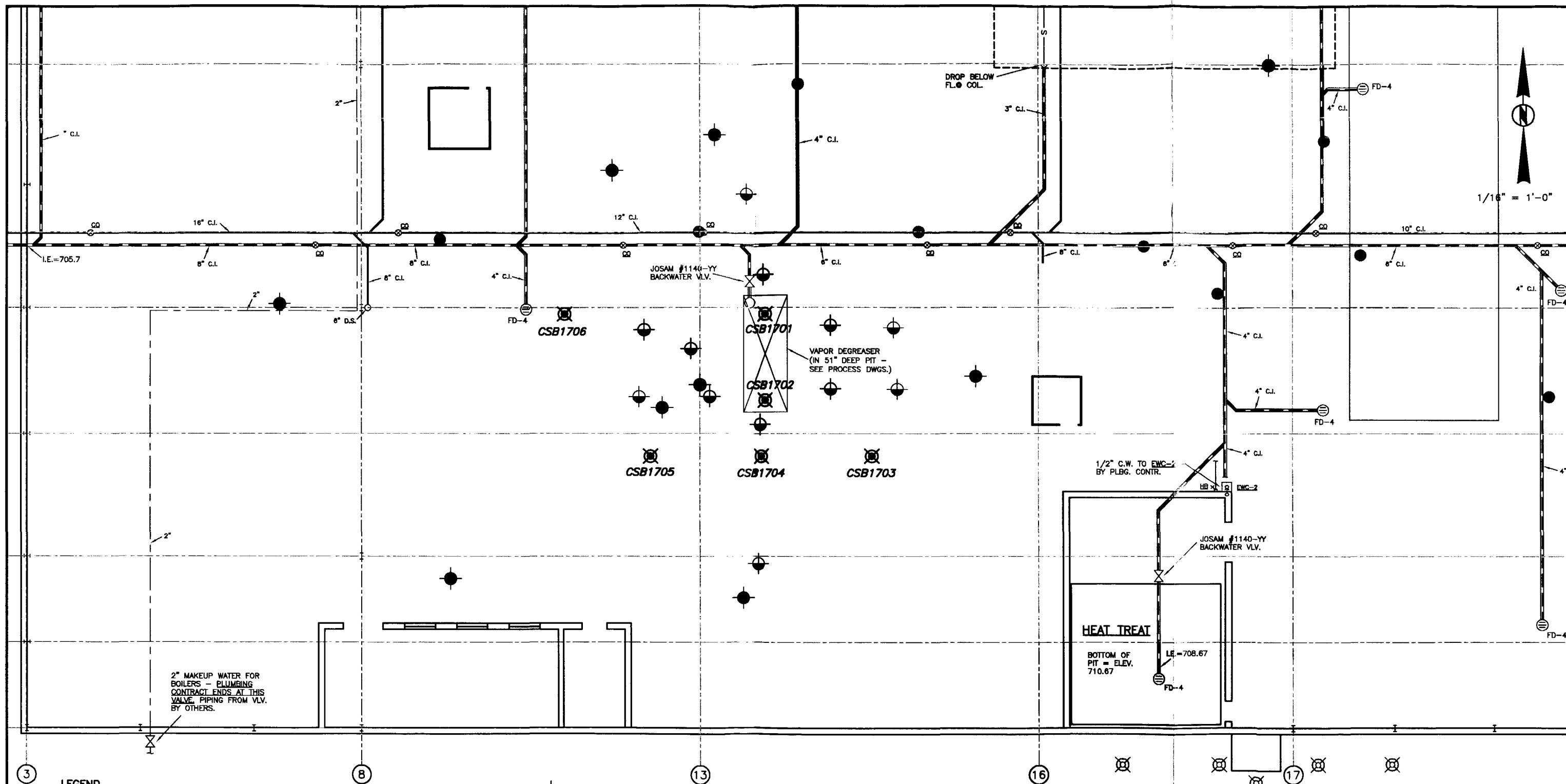
CHECK BY	
DRAWN BY	BCP
DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010D
PRJ NO.	65263.01

SOIL BORING GRID LAYOUT
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

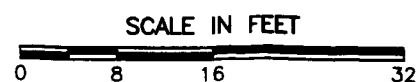
19



LEGEND

- ⊗ PROPOSED SOIL BORING LOCATION
- SEWER SYSTEM INVESTIGATION SOIL BORINGS BY CLAYTON
- ⊕ VAPOR DEGREASER INVESTIGATION SOIL BORING BY CLAYTON
- ⊗ SOUTH DOOR INVESTIGATION SOIL BORINGS BY CLAYTON
- SOIL BORING OF GEOPROBE COMPLETED BY STS (1997)

NOTE:
RED SYMBOLS IDENTIFY THE LOCATION OF SAMPLES WHERE INDIVIDUAL VOCs EXCEEDED THE RAO'S.



CHECK BY	
DRAWN BY	BCP
DATE	4-5-02
SCALE	AS SHOWN
CAD NO.	65263010C
PRJ NO.	65263.01

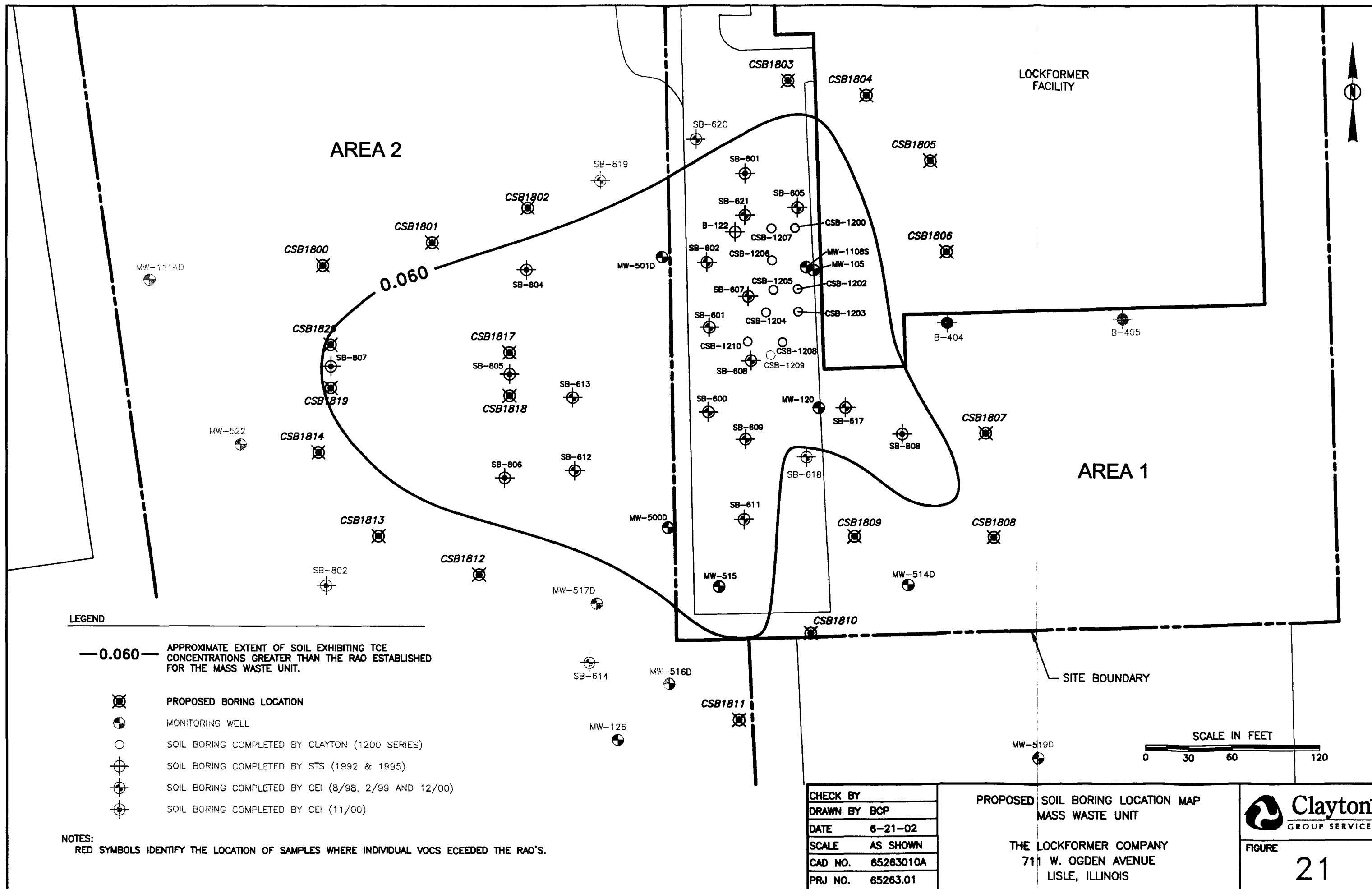
PROPOSED SOIL BORING LOCATION MAP FORMER DEGREASER AREA

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS









FIGURE

20



LEGEND

—0.060— APPROXIMATE EXTENT OF SOIL EXHIBITING TCE CONCENTRATIONS GREATER THAN THE RAO ESTABLISHED FOR THE MASS WASTE UNIT.

-  PROPOSED BORING LOCATION
-  MONITORING WELL
-  SOIL BORING COMPLETED BY CLAYTON (1200 SERIES)
-  SOIL BORING COMPLETED BY STS (1992 & 1995)
-  SOIL BORING COMPLETED BY CEI (8/98, 2/99 AND 12/00)
-  SOIL BORING COMPLETED BY CEI (11/00)

NOTES:
RED SYMBOLS IDENTIFY THE LOCATION OF SAMPLES WHERE INDIVIDUAL VOCs EXCEEDED THE RAO'S.

CHECK BY	
DRAWN BY	BCP
DATE	6-21-02
SCALE	AS SHOWN
CAD NO.	65263010A
PRJ NO.	65263.01

PROPOSED SOIL BORING LOCATION MAP
MASS WASTE UNIT

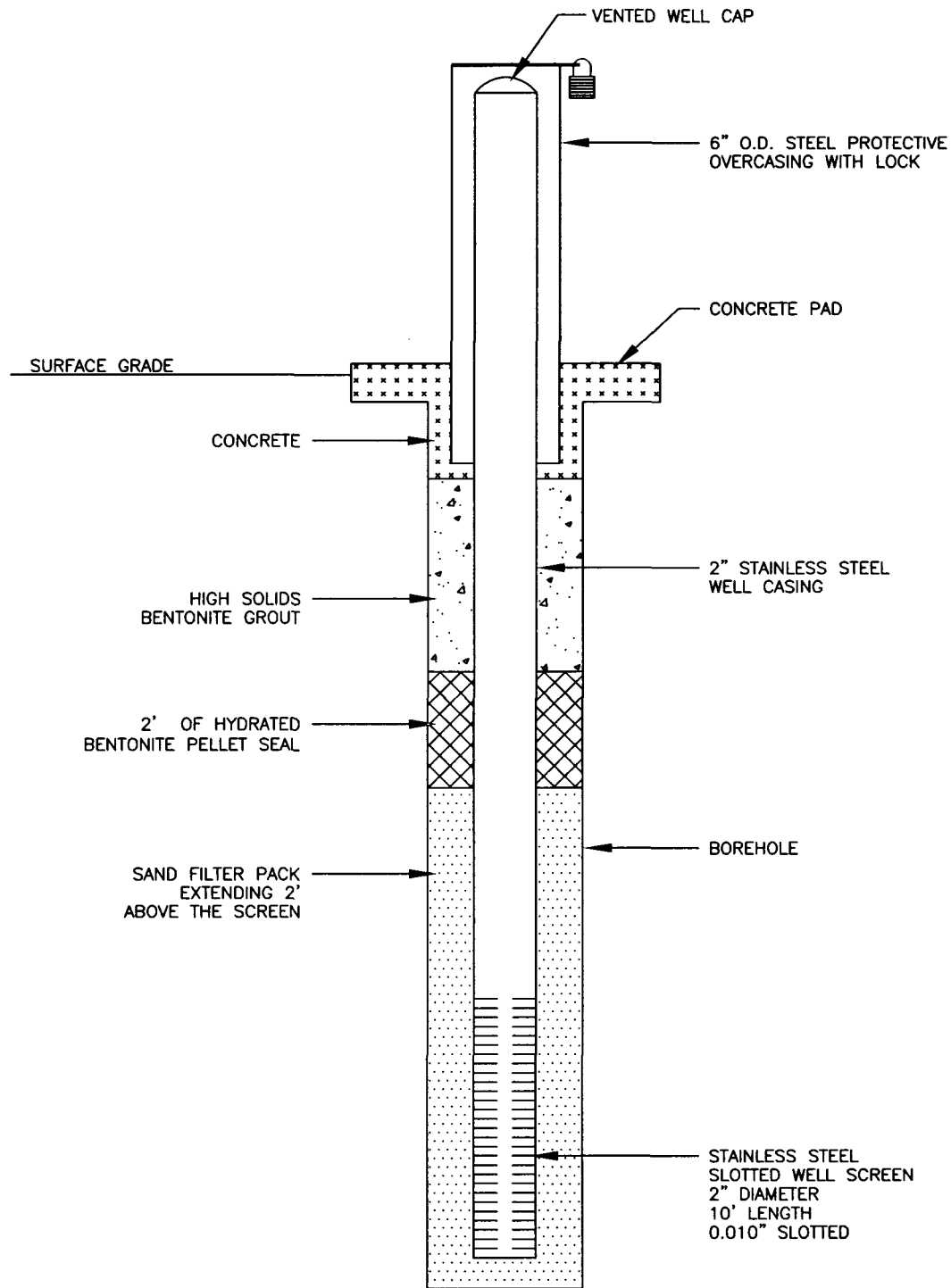
THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS

SCALE IN FEET
0 30 60 120



FIGURE

21



CHECK BY	
DRAWN BY	OS
DATE	6-21-02
SCALE	AS SHOWN
CAD NO.	65263010V
PRJ NO.	65263.01.

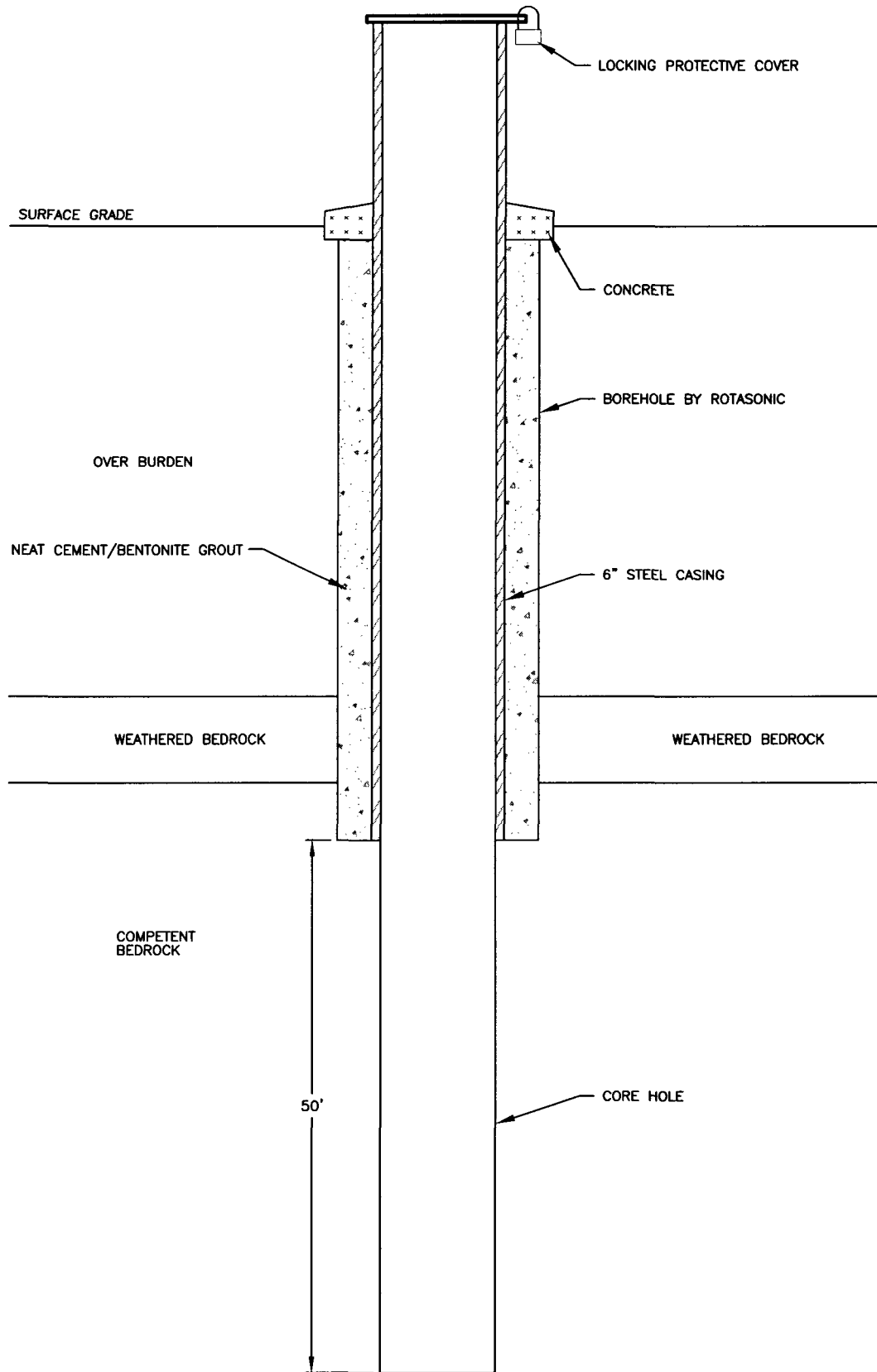
WELL CONSTRUCTION DIAGRAM: WATER-BEARING SEDIMENTS

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

23



CHECK BY WSE
DRAWN BY OS/BCP
DATE 6-21-02
SCALE AS SHOWN
CAD NO. 65263010W
PRJ NO. 65263.01

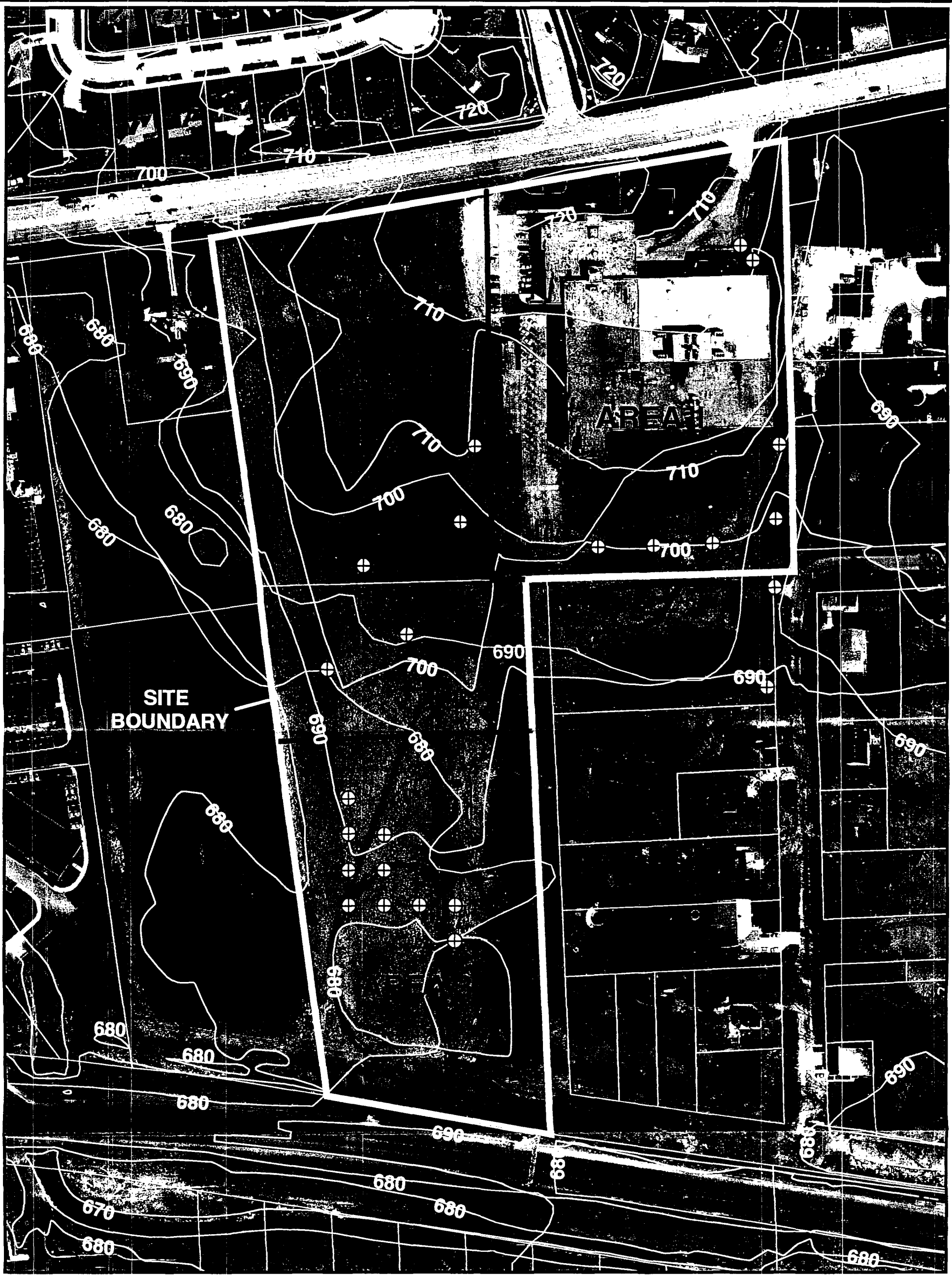
BEDROCK WELL
CONSTRUCTION DIAGRAM

THE LOCKFORMER COMPANY
711 W. OGDEN AVENUE
LISLE, ILLINOIS



FIGURE

24



**SITE TOPOGRAPHIC MAP: 1962 / 2001
THE LOCKFORMER COMPANY / LISLE, ILLINOIS**



Legend



Surface Drainage Way Boring Locations

1962 Surface Contours 10 Foot Interval

2001 Surface Contours 10 Foot Interval

Parcel Boundaries



Note: Map Sources

Aerial photograph, property boundaries and 2001 contours obtained from DuPage County Government, date of aerial photography: April 1998.
1962 contour lines obtained from 1962 (Rev. 1972 / 1980) USGS Quadrangle - Wheaton, IL

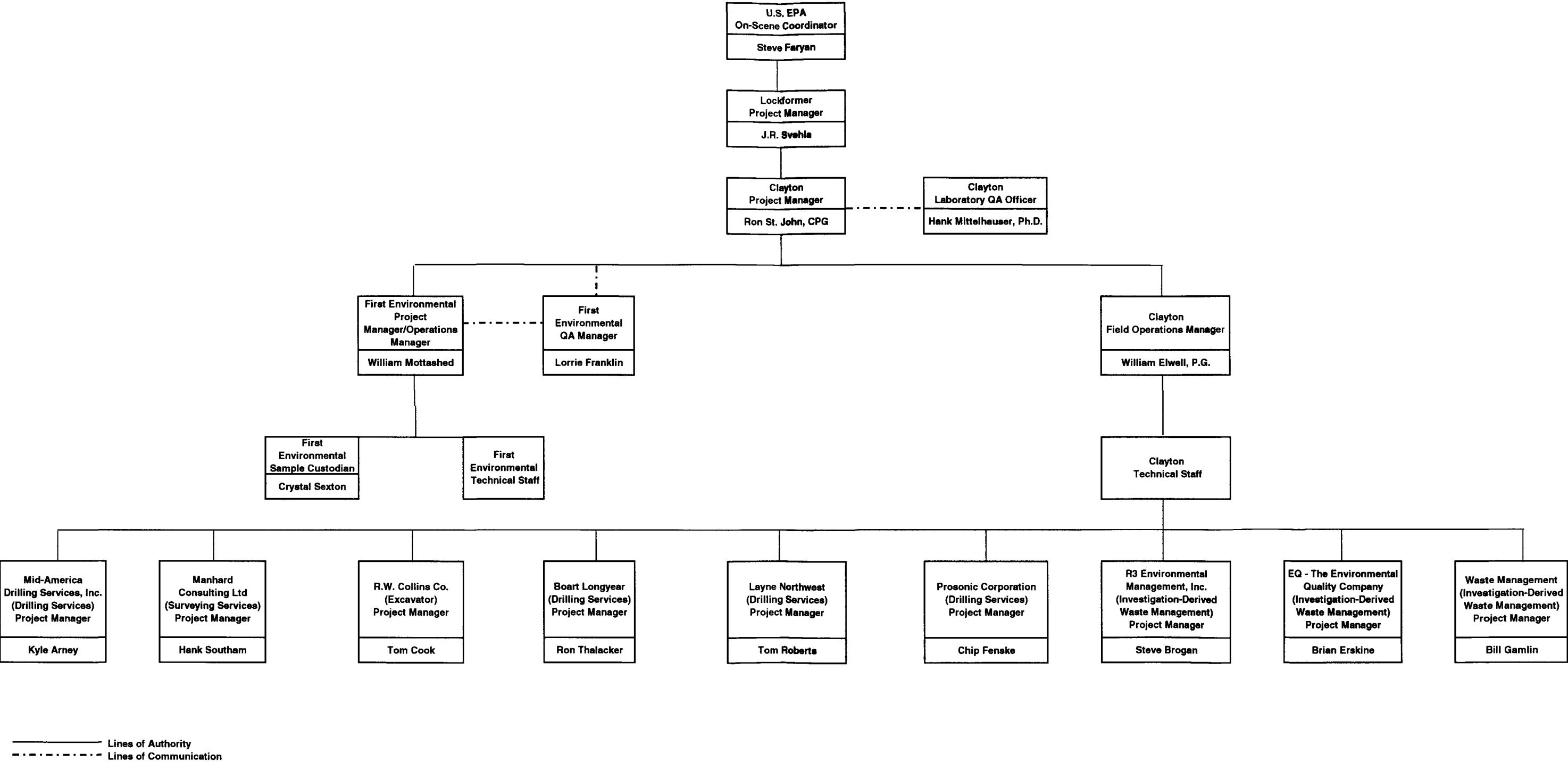
Map is in Illinois State Plane, NAD 83, Feet

Project: 15-65263.01
SiteTopoMap_R.MXD
Date: 03/29/02
Drawn by: SFS



FIGURE 26

Figure 27 -- Project Organization Chart



Lockformer Work Plan QAPP
Date: 2/28/2003
65263.01- Rev.3

TABLES

TABLE 1
Summary of Removal Action Objectives (RAOs) and Delineation Objectives

The Lockformer Company / Lisle, Illinois

Compound	Areas 1 and 2		Area 3	
	RAO for Surficial Silty Clay Till/Fill ^a (mg/kg)	RAO for Mass Waste Unit ^b (mg/kg)	RAO for Soil ^c (mg/kg)	Delineation Objective for Groundwater ^d (mg/L)
Acetone	100,000	16	16	0.7
Benzene	1.6	0.03	0.03	0.005
Bromodichloromethane	3,000	0.6	0.6	0.0002
Bromoform	100	0.8	0.8	0.001
Bromomethane	15	0.2	0.2	0.0098
2-Butanone	NE	NE	NE	NE
Carbon disulfide	720	32	9	0.7
Carbon tetrachloride	0.64	0.07	0.07	0.005
Chlorobenzene	210	1	1	0.1
Chlorodibromomethane	1,300	0.4	0.4	0.14
Chloroethane	NE	NE	NE	NE
Chloroform	0.54	0.6	0.3	0.0002
Chloromethane	NE	NE	NE	NE
1,1-Dichloroethane	1,700	23	23	0.7
1,2-Dichloroethane	0.7	0.02	0.02	0.005
1,1-Dichloroethene	1,500	0.06	0.06	0.007
cis-1,2-Dichloroethene	1,200	0.4	0.4	0.07
trans-1,2-Dichloroethene	3,100	0.7	0.7	0.1
1,2-Dichloropropane	23	0.03	0.03	0.005
cis-1,3-Dichloropropene	2.1	0.004	0.004	0.001
trans-1,3-Dichloropropene				
Ethylbenzene	400	13	13	0.7
2-Hexanone	NE	NE	NE	NE
4-Methyl-2-pentanone	NE	NE	NE	NE
Methylene chloride	24	0.02	0.02	0.005
Styrene	1,500	4	4	0.1
1,1,2,2-Tetrachloroethane	NE	NE	NE	NE
Tetrachloroethene	20	0.06	0.06	0.005
Toluene	650	12	12	1.0
1,1,1-Trichloroethane	1,200	2	2	0.2
1,1,2-Trichloroethane	1,800	0.02	0.02	0.005
Trichloroethene	8.9	0.06	0.06	0.005
Vinyl acetate	1,600	170	10	7
Vinyl chloride	1.1	0.01	0.01	0.002
Xylenes (total)	320	150	150	10

NOTES:

^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Most conservative value contained in Appendix B, Tables A and B of 35 IAC 742.

^d = TACO Tier 1 groundwater remediation objectives for the groundwater component of the class I groundwater ingestion route established in 35 IAC 742 Appendix B, Table E.

NE = Not Established

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1300			CSB-1301			CSB-1302			CSB-1303		
			2-4 ft	4-6 ft	12-14 ft	6-8 ft	10-12 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	4-6 ft	14-16 ft
			CL	CL	ML	CL	CL	CL	CL	CL	CL	sand fill	sand fill	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	0.179	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	0.036	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	0.157	0.555	0.0084	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	0.0026	0.0212	0.0015	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
trans,1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	0.005	0.005	0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005
Trichloroethene	8.9	0.06	0.0097	3.61	<0.005	0.0036	0.051	0.0027	<0.005	<0.005	<0.005	<0.005	1.07	<0.005
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005

NOTES: ^a = Value based on industrial/commercial ~~waste~~ soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1304			CSB-1305			CSB-1306			CSB-1307		
			2-4 ft	8-10 ft	14-16 ft	8-10 ft	10-12 ft	14-16 ft	4-6 ft	10-12 ft	14-16 ft	8-10 ft	10-12 ft	14-16 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.1	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Fill/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1308			CSB-1309			CSB-1310			CSB-1311		
			2-4 ft	12-14 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	0-2 ft	2-4 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	0.085	<0.010	<0.010	<0.010	<0.010	<0.010	0.131	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	0.005	<0.010	<0.010	<0.010	<0.010	<0.010	0.0129	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	0.0048	<0.005	<0.005	<0.005	<0.005	<0.005	0.0158	0.0683	<0.005	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1312			CSB-1313			CSB-1314			CSB-1315		
			2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	4-6 ft	8-10 ft	14-16 ft	4-6 ft	6-8 ft	14-16 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	sand fill	CL	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
trans,1-3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,1,1-Trichloroethane	1,200	2	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.100	<0.005
Trichloroethene	8.9	0.06	<0.005	<0.005	<0.005	0.0296	<0.005	<0.005	<0.005	<0.005	<0.005	2.52	14.7	0.011
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.100	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0055	<0.005	<0.100	<0.100	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Tail/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c														
			CSB-1316			CSB-1317			CSB-1318						CSB-1319		
			2-4 ft	4-6 ft	14-16 ft	2-4 ft	4-6 ft	14-16 ft	4-6 ft	6-8 ft	10-12 ft	12-14 ft	16-18 ft	0-2 ft	2-4 ft	14-16 ft	
			CL	CL	CL	CL	CL	CL	sand fill	CL	CL	CL	CL	CL	sand fill	CL	CL
Acetone	100,000	16	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Benzene	1.6	0.03	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Bromodichloromethane	3,000	0.6	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Bromoform	100	0.8	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Bromomethane	15	0.2	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
2-Butanone	NE	NE	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Carbon disulfide	720	32	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Carbon tetrachloride	0.64	0.07	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Chlorobenzene	210	1	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Chlorodibromomethane	1,300	0.4	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Chloroethane	NE	NE	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Chloroform	0.54	0.6	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Chloromethane	NE	NE	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
1,1,-Dichloroethane	1,700	23	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
1,2-Dichloroethane	0.7	0.02	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
1,1,-Dichloroethene	1,500	0.06	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
cis,1-2-Dichloroethene	1,200	0.4	<0.100	<0.005	<0.005	<0.100	0.0308	<0.005	1.01	12.4	8.67	2.9	0.0355	<0.100	<0.100	<0.005	
trans,1-2-Dichloroethene	3,100	0.7	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	0.219	0.16	0.0053	<0.100	<0.100	<0.005	
1,2-Dichloropropane	23	0.03	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
cis,1-3-Dichloropropene	2.1	0.004	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
trans,1,3-Dichloropropene			<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Ethyl benzene	400	13	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
2-Hexanone	NE	NE	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
4-Methyl-2-pentanone	NE	NE	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Methylene chloride	24	0.02	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Styrene	1,500	4	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
1,1,2,2-Tetrachloroethane	NE	NE	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Tetrachloroethene	20	0.06	0.465	0.0182	<0.005	5.81	0.0284	<0.005	1.32	<0.100	<0.100	<0.100	<0.005	<0.100	0.216	<0.005	
Toluene	650	12	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
1,1,1-Trichloroethane	1,200	2	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
1,1,2-Trichloroethane	1,800	0.02	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	
Trichloroethene	8.9	0.06	23.3	6.37	0.0039 J	147	9.2	<0.005	81.3	<0.100	3.35	4.6	0.0356	5.04	26.4	<0.005	
Vinyl acetate	1,600	170	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Vinyl chloride	1.1	0.01	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.100	<0.100	<0.100	<0.010	<0.100	<0.100	<0.010	
Xylenes (total)	320	150	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.100	<0.100	<0.100	<0.005	<0.100	<0.100	<0.005	

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

From: <Mikesers@aol.com>
To: <rchadwick@claytongrp.com>
Date: 11/5/02 5:36AM
Subject: Emergency Costs

Goodmorning Russ,
For 11/1: Emergency rates doubled;
Bernie (\$75/hr reg. OT) 5 hrs (Fri & Sat) @ \$150/hr \$750
Bobcat 4hrs @ \$100/hr \$400
Pick up truck \$85
Total \$1235

Excavation, transportation, backfill:
Equipment and labor; \$1565
Transportation \$250/lb
Backfill \$15/cy

you are paying disposal, right?

Mike

CC: <jcanner@mccartingrp.com>

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay TiWFill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1320			CSB-1321			CSB-1322			CSB-1323		
			2-4 ft	4-6 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft
			sand fill	sand fill	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Acetone	100,000	16	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	0.0915	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromofom	100	0.8	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	0.0111	<0.005	<0.005	0.0119	<0.005	<0.005
Toluene	650	12	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	1.53	10.6	0.0064	<0.005	<0.005	<0.005	0.480	<0.005	<0.005	0.26	<0.005	<0.005
Vinyl acetate	1,600	170	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 2
Clayton Soil Borings Inside the Facility Building
Around the Storm and Sanitary Sewer, and the Vapor Degreaser

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Tim/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c												
			CSB-1324			CSB-1325			CSB-1326			CSB-1327			CSB-1328
			2-4 ft	8-10 ft	14-16 ft	0-2 ft	2-4 ft	14-16 ft	2-4 ft	4-6 ft	14-16 ft	2-4 ft	10-12 ft	14-16 ft	0-2 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	GP	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	0.0147	0.168	<0.005	<0.005	<0.005	<0.005	0.0056	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	0.0089	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	0.0062	<0.005	<0.005	0.0053	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	0.0193	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	8.56	0.0079	<0.005	5.62	14.7	<0.005	3.67	4.27	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker **soil** remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the **soil** component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 3
Clayton Soil Boring Results
Around South Exterior Door

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1401			CSB-1402			CSB-1403			CSB-1404		
			0-2 ft	8-10 ft	14-16 ft	0-2 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	4-6 ft	14-16 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Acetone	100,000	16	0.0844	0.0227	0.0206	0.0704	0.0269	0.0311	0.0141	0.0156	0.0276	<0.010	0.0416	0.0454
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	0.0012	<0.005	<0.005	<0.005	<0.005	<0.005	0.0019	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	0.0016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	0.0081	0.0035	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	0.0056	<0.005	<0.005	0.0065	<0.005	<0.005	<0.005	<0.005	0.0042	<0.005	0.0042	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	0.0018	<0.005	<0.005	<0.005	<0.005	<0.005	0.0033	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0028	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans-1,2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans-1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	0.0068	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	0.0016	<0.005	<0.005	0.0016	<0.005	0.0017	0.0018	<0.005	0.0014	0.0021	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	<0.005	<0.005	<0.005	<0.005	0.0089	<0.005	<0.005	<0.005	<0.005	<0.005	0.0017	<0.005
Vinyl Acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	1.1	0.01	<0.010	<0.010	0.0021	<0.010	<0.010	0.0059	<0.010	<0.010	0.0057	<0.010	<0.010	0.0031
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class 1 groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 3
Clayton Soil Boring Results
Around South Exterior Door

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Ti/FFill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1405			CSB-1406			CSB-1407			CSB-1408		
			2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft	2-4 ft	8-10 ft	14-16 ft
			CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Acetone	100,000	16	0.0199	0.0154	0.0144	0.109	0.0942	0.0215	0.0873	0.0799	0.0255	0.199	0.0523	0.0184
Benzene	1.6	0.03	0.0012	<0.005	0.0014	<0.005	<0.005	0.0015	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	0.0106	<0.010	0.0070	0.0053	<0.010	0.0245	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0043	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	0.0031	0.0031	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	1,700	23	<0.005	0.0057	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,2-Dichloroethene	1,200	0.4	<0.005	0.0048	0.0025	<0.005	0.0055	0.0107	<0.005	<0.005	<0.005	<0.005	0.0072	<0.005
trans-1,2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans-1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	0.0072	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	0.0011	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	0.002	0.0012	0.0023	<0.005	<0.005	0.002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	0.0243	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	0.0018	0.0632	<0.005	0.0063	<0.005	<0.005	<0.005	0.0052	<0.005	0.0029	0.0082	<0.005
Vinyl Acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	1.1	0.01	<0.010	<0.010	0.0014	<0.010	0.0088	0.0026	<0.010	<0.010	0.0016	<0.010	0.0057	0.0024
Xylenes (total)	320	150	0.0019	0.0016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

NE = Not Established

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

Bold = Detected

Bold = Exceeds Objective

TABLE 4
Soil Analytical Results
Sewer System Sediment

The Lockformer Company / Lisle, Illinois

COMPOUNDS	*Soil Objective (mg/kg)	SAMPLE LOCATION		
		MH-1	MH-4	CB-1
Acetone	16	<0.010	<0.010	<0.010
Benzene	0.03	<0.005	<0.005	<0.005
Bromodichloromethane	0.6	<0.005	<0.005	<0.005
Bromoform	0.8	<0.005	<0.005	<0.005
Bromomethane	0.2	<0.010	<0.010	<0.010
2-Butanone	NE	<0.010	<0.010	<0.010
Carbon disulfide	9	<0.005	<0.005	<0.005
Carbon tetrachloride	0.07	<0.005	<0.005	<0.005
Chlorobenzene	1	<0.005	<0.005	<0.005
Chlorodibromomethane	0.4	<0.005	<0.005	<0.005
Chloroethane	NE	<0.010	<0.010	<0.010
Chloroform	0.54	<0.005	<0.005	<0.005
Chloromethane	NE	<0.010	<0.010	<0.010
1,1,-Dichloroethane	23	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.02	<0.005	<0.005	<0.005
1,1,-Dichloroethene	0.06	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	0.4	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	0.7	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.03	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	0.004	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene		<0.005	<0.005	<0.005
Ethyl benzene	13	<0.005	<0.005	<0.005
2-Hexanone	NE	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	<0.010	<0.010	<0.010
Methylene chloride	0.02	<0.005	<0.005	<0.005
Styrene	4	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	<0.005	<0.005	<0.005
Tetrachloroethene	0.06	<0.005	<0.005	<0.005
Toluene	12	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	2	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.02	<0.005	<0.005	<0.005
Trichloroethene	0.06	<0.005	<0.005	<0.005
Vinyl acetate	10	<0.010	<0.010	<0.010
Vinyl chloride	0.01	<0.010	<0.010	<0.010
Xylenes (total)	150	<0.005	<0.005	<0.005

NOTES:

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

* = Most conservative remediation objective established in 35 IAC 742 Appendix B, Table B.

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c									
			CSB-1200					CSB-1201				
			6-8 ft	12-14 ft	32-34 ft	46-48 ft	48-50 ft	6-8 ft	14-16 ft	20-22 ft	52-54 ft	56-58 ft
			CL	CL	CL	SW	CL	CL	CL	CL	SW	CL
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	0.0279	<0.010	<0.100	<0.010
Benzene	1.6	0.03	<0.005	0.0068	<0.005	<0.005	<0.005	<0.100	0.0114	<0.005	<0.100	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0123	<0.005	<0.100	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0899	0.081	<0.100	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0074	<0.005	<0.100	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0608	0.0428	<0.100	<0.005
cis,1-2-Dichloroethene	1,200	0.4	0.2	<0.005	<0.005	<0.005	<0.005	3.47	3.49	0.0805	<0.100	<0.005
trans,1-2-Dichloroethene	3,100	0.7	0.0205	<0.005	<0.005	<0.005	<0.005	<0.100	0.0232	0.015	<0.100	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
trans,1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.119	<0.005	<0.100	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	0.0076	<0.005	0.538	11.5	<0.005	0.336	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0315	<0.005	<0.100	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	0.0135	<0.005	0.0011	<0.005	<0.100	0.0311	<0.005	<0.100	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0163	<0.005	<0.100	<0.005
Trichloroethene	8.9	0.06	<0.005	103	0.609	50.9	2.14	28.9	2,280	65.4	42.3	0.0064
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.100	0.0149	0.0287	<0.100	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.100	0.0018	<0.005	<0.100	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1202											
			8-10 ft CL	12-14 ft CL	26-28 ft CL	38-40 ft GP	48-50 ft CL	50-52 ft CL	56-58 ft CL	60-62 ft CL	66-68 ft SP	72-74 ft SP	78-80 ft wthr bed	82-84 ft wthr bed
Acetone	100,000	16	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	1,700	23	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Dichloroethene	1,500	0.06	<1.000	4.86	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	12.3	55	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<1.000	1.95	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<1.000	<1.000	<0.005	0.371	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	24.2	89	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	99.2	512	<0.005	11.5	0.79	0.0074	0.472	0.0149	<0.005	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<1.000	<1.000	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<1.000	<1.000	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742,

Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Boxed Bold = Detected

Boxed Bold = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c											
			CSB-1203					CSB-1204						
			8-10 ft	10-12 ft	22-24 ft	30-32 ft	48-50 ft	6-8 ft	10-12 ft	26-28 ft	30-32 ft	42-44 ft	50-52 ft	53 ft
			CL	CL	CL	GP	CL	CL	CL	CL	SW	SW	CL	CL
Acetone	100,000	16	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	38.9	33.2	<0.005	<0.100	<0.005	4.64	8.27	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<1.000	<1.000	<0.005	<0.100	<0.005	0.333	0.263	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	0.123	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	0.0073	0.0126	<0.005	<0.005
Toluene	650	12	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	4.13	10.8	<0.005	<0.100	<0.005	0.0208	0.432	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	156	206	<0.005	3.09	<0.005	5.83	51.2	0.0054	0.59	1.1	<0.005	0.0055
Vinyl acetate	1,600	170	<1.000	<1.000	<0.010	<0.100	<0.010	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<1.000	<1.000	<0.010	<0.100	<0.010	0.531	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<1.000	<1.000	<0.005	<0.100	<0.005	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Box = Detected

Box = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c							
			CSB-1205							
			8-10 ft	10-12 ft	20-22 ft	34-36 ft	44-46 ft	46-48 ft	50-52 ft	56-58 ft
			CL	CL	CL	SP	CL	CL	CL	SW
Acetone	100,000	16	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	1.96	4.16	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.100	0.0256	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.100	<0.005	<0.005	0.0165	0.0143	<0.005	<0.005	<0.005
Toluene	650	12	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.100	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	116	172	0.0725	0.913	0.634	0.624	0.0123	0.0041
Vinyl acetate	1,600	170	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: * = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c							
			CSB-1206							
			2-4 ft	10-12 ft	22-24 ft	36-38 ft	44-46 ft	48-50 ft	52-54 ft	58-60 ft
			CL	CL	CL	SW	SW	CL	CL	SM
Acetone	100,000	16	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	0.593	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	0.0143	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.100	<0.005	0.239	0.218	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	<0.005	5.23	<0.005	8.36	6.24	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.100	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.100	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c								
			CSB-1207								
			6-8 ft CL	12-14 ft CL	22-24 ft CL	30-32 ft CL	36-38 ft GW	44-46 ft GW	50-52 ft CL	58-60 ft CL	74-76 ft SM
Acetone	100,000	16	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.005	<0.005	<0.005	0.0085	0.0214	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<0.005	<0.005	<0.005	0.0057	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	<0.005	<0.005	<0.005	<0.005	0.914	20.1	0.115	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c							
			CSB-1208							
			8-10 ft CL	12-14 ft CL	28-30 ft CL	32-34 ft GW	44-46 ft SP	48-50 ft CL	52-54 ft CL	62-64 ft SM
Acetone	100,000	16	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	0.0062	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	0.0109	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	0.109	0.175	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	0.0337	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	0.0779	0.111	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	38	30	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	0.656	0.716	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	0.0317	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	0.015	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	15.4	2.94	0.582	0.11	0.911	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	0.031	0.127	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c								
			CSB-1209								
			8-10 ft CL	12-14 ft CL	22-24 ft CL	28-30 ft CL	34-36 ft SP	40-42 ft SP	46-48 ft CL	52-54 ft CL	64-66 ft SP
Acetone	100,000	16	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	1.6	0.03	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	3,000	0.6	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	100	0.8	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	15	0.2	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon disulfide	720	32	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon tetrachloride	0.64	0.07	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	210	1	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	1,300	0.4	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.54	0.6	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1,-Dichloroethane	1,700	23	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.7	0.02	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,-Dichloroethene	1,500	0.06	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-2-Dichloroethene	1,200	0.4	19.2	21.4	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1-2-Dichloroethene	3,100	0.7	0.365	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	23	0.03	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis,1-3-Dichloropropene	2.1	0.004	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trans,1,3-Dichloropropene			<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethyl benzene	400	13	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-pentanone	NE	NE	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene chloride	24	0.02	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	1,500	4	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	20	0.06	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	650	12	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	1,200	2	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	1,800	0.02	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	8.9	0.06	2.36	3.91	<0.005	<0.005	0.0576	0.118	<0.005	<0.005	<0.005
Vinyl acetate	1,600	170	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl chloride	1.1	0.01	<0.010	<1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (total)	320	150	<0.005	<1.000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Bold = Detected **Bold** = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c									
			CSB-1210									
			6-8 ft	10-12 ft	24-26 ft	36-38 ft	42-44 ft	48-50 ft	54-56 ft	58-60 ft	68-70 ft	
			CL	CL	CL	SP	SP	CL	SM	SM	SM	
Acetone	100,000	16	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzene	1.6	0.03	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromodichloromethane	3,000	0.6	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromoform	100	0.8	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromomethane	15	0.2	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
2-Butanone	NE	NE	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Carbon disulfide	720	32	1	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Carbon tetrachloride	0.64	0.07	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chlorobenzene	210	1	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chlorodibromomethane	1,300	0.4	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chloroethane	NE	NE	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Chloroform	0.54	0.6	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chloromethane	NE	NE	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
1,1,-Dichloroethane	1,700	23	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloroethane	0.7	0.02	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,-Dichloroethene	1,500	0.06	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
cis,1-2-Dichloroethene	1,200	0.4	6.56	13.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
trans,1-2-Dichloroethene	3,100	0.7	<1.000	0.414	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloropropane	23	0.03	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
cis,1-3-Dichloropropene	2.1	0.004	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
trans,1,3-Dichloropropene			<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Ethyl benzene	400	13	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
2-Hexanone	NE	NE	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
4-Methyl-2-pentanone	NE	NE	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylene chloride	24	0.02	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Styrene	1,500	4	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,2,2-Tetrachloroethane	NE	NE	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Tetrachloroethene	20	0.06	1.2	0.45	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Toluene	650	12	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,1-Trichloroethane	1,200	2	<1.000	0.181	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,2-Trichloroethane	1,800	0.02	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Trichloroethene	8.9	0.06	18.9	74.5	<0.005	0.194	0.816	<0.005	<0.005	<0.005	<0.005	
Vinyl acetate	1,600	170	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Vinyl chloride	1.1	0.01	<1.000	<0.100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Xylenes (total)	320	150	<1.000	<0.100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Bold = Detected

Bold = Exceeds Objective

TABLE 5
Soil Sample Results
1200 Series Borings in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	RAO for Surficial Silty Clay Till/Fill ^a	RAO for Mass Waste Unit ^b	SAMPLE LOCATION, DEPTH AND MATERIAL ^c									
			MW-1108S									
			2-4 ft	14-16 ft	20-22 ft	28-30 ft	36-38 ft	46-48 ft	48-50 ft	56-58 ft	64-66 ft	
			CL	CL	CL	CL	SP	SP	CL	CL	SP	
Acetone	100,000	16	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Benzene	1.6	0.03	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Bromodichloromethane	3,000	0.6	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Bromoform	100	0.8	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Bromomethane	15	0.2	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
2-Butanone	NE	NE	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Carbon disulfide	720	32	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Carbon tetrachloride	0.64	0.07	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Chlorobenzene	210	1	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Chlorodibromomethane	1,300	0.4	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Chloroethane	NE	NE	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Chloroform	0.54	0.6	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Chloromethane	NE	NE	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
1,1-Dichloroethane	1,700	23	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,2-Dichloroethane	0.7	0.02	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,1,1-Dichloroethene	1,500	0.06	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
cis,1-2-Dichloroethene	1,200	0.4	38.2	11.6	0.0033	0.0032	0.182	<0.100	<0.005	<0.005	<0.005	
trans,1-2-Dichloroethene	3,100	0.7	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,2-Dichloropropane	23	0.03	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
cis,1-3-Dichloropropene	2.1	0.004	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
trans,1,3-Dichloropropene			<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Ethyl benzene	400	13	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
2-Hexanone	NE	NE	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
4-Methyl-2-pentanone	NE	NE	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Methylene chloride	24	0.02	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Styrene	1,500	4	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,1,2,2-Tetrachloroethane	NE	NE	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Tetrachloroethene	20	0.06	18	14.7	<0.005	<0.005	0.394	0.408	<0.005	<0.005	<0.005	
Toluene	650	12	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,1,1-Trichloroethane	1,200	2	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
1,1,2-Trichloroethane	1,800	0.02	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	
Trichloroethene	8.9	0.06	765	2,220	0.0107	0.0686	16.8	34.9	0.0186	0.0198	0.0048	
Vinyl acetate	1,600	170	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Vinyl chloride	1.1	0.01	<5.000	<1.000	<0.010	<0.010	<0.100	<0.100	<0.010	<0.010	<0.010	
Xylenes (total)	320	150	<5.000	<1.000	<0.005	<0.005	<0.100	<0.100	<0.005	<0.005	<0.005	

NOTES: ^a = Value based on industrial/commercial worker soil remediation objective for the inhalation pathway contained in 35 IAC 742, Appendix B, Table B.

^b = TACO Tier 1 soil remediation objective for the soil component of the groundwater ingestion pathway (Class I groundwater) established in 35 IAC 742 Appendix B, Table B.

^c = Unified Soil Classification System (USCS).

Values expressed in milligrams per kilogram (mg/kg) or parts per million (ppm).

NE = Not Established

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1203			CSB-1204			
	43 ft	46 ft	53 ft	5 ft	25 ft	33 ft	46 ft
Non-Carbonate Organic Carbon (%)	0.1805	0.9225	0.669	0.7725	0.8055	0.376	0.283
Grain Size (USCS)	Sandy Gravel, Little Silt, GP-GM	Silty Clay, Trace Sand, Trace Gravel, CL	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Trace Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL	Sand, Some Gravel, Little Silt, SW-SM	Sandy Gravel, Trace Silt, Trace Clay, GW-GM
Moisture Content (%)	NA	18.3	17.9	27.8	21.4	NA	NA
Specific Gravity	2.70	2.75	2.75	2.75	2.75	2.70	2.70
Bulk Density (pounds/ft ³)	NA	132.3	132.8	121.4	128.8	NA	NA

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1204				CSB-1205		
	50 ft	54 ft	56 ft	70 ft	5 ft	26 ft	32 ft
Non-Carbonate Organic Carbon (%)	0.872	0.8825	0.243	0.0979	0.544	0.812	0.268
Grain Size (USCS)	Silty Clay, Trace Sand, Trace Gravel, CL	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Trace Gravel, CL	Silty Clay, Some Sand, Trace Gravel, CL	Silty Clay, Some Sand, Trace Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL	Sand, Some Gravel, Little Silt, SP-SM
Moisture Content (%)	21.7	22.8	11.4	15.3	22.0	22.6	NA
Specific Gravity	2.75	2.75	2.79	2.79	2.79	2.75	2.70
Bulk Density (pounds/ft ³)	129.0	126.5	143.8	137.5	125.2	127.0	NA

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1205					CSB-1206	
	45 ft	49 ft	54 ft	60 ft	73 ft	3 ft	33 ft
Non-Carbonate Organic Carbon (%)	0.2635	0.5115	0.8635	0.1835	0.0772	0.5505	0.8435
Grain Size (USCS)	Gravelly Sand, Little Silt, SW-SM	Silty Clay, Some Sand, CL	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Little Gravel, CL	Sand, Little Silt, SP-SM	Silty Clay, Little Sand, Trace Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL
Moisture Content (%)	NA	14.3	20.8	8.6	NA	20.0	22.5
Specific Gravity	2.70	2.79	2.75	2.79	2.70	2.75	2.75
Bulk Density (pounds/ft ³)	NA	139.1	128.5	149.6	NA	129.8	127.3

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1206						
	36 ft	47 ft	49 ft	53 ft	56 ft	59 ft	75 ft
Non-Carbonate Organic Carbon (%)	0.2545	0.212	0.6325	0.825	0.688	0.172	0.0854
Grain Size (USCS)	Gravelly Sand, Little Silt, SW-SM	Sand, Trace Gravel, Some Silt, SM	Silty Clay, Trace Sand, CL	Silty Clay, Trace Sand, CL	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Trace Gravel, CL	Clayey Sand, Trace Gravel, SC
Moisture Content (%)	NA	NA	18.1	19.1	22.9	10.5	16.1
Specific Gravity	2.70	2.70	2.75	2.75	2.75	2.79	2.78
Bulk Density (pounds/ft ³)	NA	NA	132.8	131.6	127.3	145.8	126.7

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1207						
	3 ft	33 ft	36 ft	47 ft	51 ft	64 ft	67 ft
Non-Carbonate Organic Carbon (%)	0.472	0.827	0.143	0.27	0.84	0.22	0.06
Grain Size (USCS)	Silty Clay, Some Sand, Trace Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL	Gravel, Some Sand, Little Silt, GW-GM	Sand, Little Gravel, Some Silt, SM	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Trace Gravel, CL	Silty Sand, Trace Clay, SM
Moisture Content (%)	18.3	17.3	NA	NA	19.0	15.0	15.3
Specific Gravity	2.79	2.79	2.70	2.70	2.75	2.79	2.78
Bulk Density (pounds/ft ³)	133.3	134.8	NA	NA	130.9	137.8	134.3

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1207	CSB-1208					
	75 ft	5 ft	28 ft	32 ft	44 ft	47 ft	52 ft
Non-Carbonate Organic Carbon (%)	0.10	0.89	0.82	0.35	0.27	0.57	0.89
Grain Size (USCS)	Clayey Sand, SM	Silty Clay, Little Sand, Trace Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL	Sandy Gravel, Little Silt, GW-GM	Sand, Some Gravel, Trace Silt, SP	Silty Clay, Some Sand, Some Gravel, CL	Silty Clay, Trace Sand, CL
Moisture Content (%)	17.1	24.5	18.9	NA	NA	17.9	22.4
Specific Gravity	2.78	2.75	2.75	2.70	2.70	2.78	2.75
Bulk Density (pounds/ft ³)	129.1	124.2	131.2	NA	NA	130.9	127.0

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1208		CSB-1209				
	57 ft	71 ft	3 ft	29 ft	33 ft	44 ft	46 ft
Non-Carbonate Organic Carbon (%)	0.17	0.21	0.28	0.81	0.32	0.32	0.86
Grain Size (USCS)	Clayey Sand, Some Gravel, SC	Silty Clay, Little Sand, Trace Gravel, CL	Silty Clay, Little Sand, Little Gravel, CL	Silty Clay, Little Sand, Trace Gravel, CL	Sand, Some Gravel, Little Silt, SP-SM	Gravelly Sand, Little Silt, SW-SM	Silty Clay, Trace Sand, CL
Moisture Content (%)	10.9	13.4	19.7	21.8	NA	NA	21.0
Specific Gravity	2.78	2.79	2.79	2.75	2.70	2.70	2.75
Bulk Density (pounds/ft ³)	144.8	140.4	127.7	128.4	NA	NA	129.0

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1209			CSB-1210			
	52 ft	57 ft	70 ft	3 ft	28 ft	31 ft	45 ft
Non-Carbonate Organic Carbon (%)	0.84	0.23	0.08	0.48	0.83	0.24	0.31
Grain Size (USCS)	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Little Gravel, CL	Silt and Sand, ML	Silty Clay, Little Sand, Trace Gravel, CL	Silty Clay, Some Sand, Trace Gravel, CL	Sand, Some Gravel, Some Silt, SM	Sand, Some Gravel, Little Silt, SP-SM
Moisture Content (%)	21.9	13.9	17.5	18.3	16.5	NA	NA
Specific Gravity	2.75	2.79	2.79	2.79	2.79	2.70	2.70
Bulk Density (pounds/ft ³)	127.8	139.6	128.0	132.8	136.4	NA	NA

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)						
	CSB-1210				MW-1108S		
	46 ft	54 ft	57 ft	69 ft	4 ft	32 ft	35 ft
Non-Carbonate Organic Carbon (%)	0.85	0.91	0.45	0.09	0.57	0.82	0.10
Grain Size (USCS)	Silty Clay, Trace Sand, Trace Gravel, CL	Silty Clay, Trace Sand, CL	Silty Clay, Some Sand, Little Gravel, CL	Sand, Some Silt, SC	Silty Clay, Little Sand, Trace Gravel, CL	Silty Clay, Some Sand, Trace Gravel, CL	Sand, Little Gravel, Some Silt, SM
Moisture Content (%)	20.7	20.5	12.0	NA	22.7	17.0	NA
Specific Gravity	2.75	2.75	2.79	2.70	2.75	2.79	2.70
Bulk Density (pounds/ft ³)	129.2	129.5	143.0	NA	126.9	134.8	NA

TABLE 6
Geotechnical Analyses
Soils in the Immediate Vicinity of the TCE Fill Pipe

The Lockformer Company / Lisle, Illinois

COMPOUNDS	SAMPLE LOCATION AND DEPTH (bgs)				
	MW-1108S				
	45 ft	49 ft	55 ft	75 ft	60 ft
Non-Carbonate Organic Carbon (%)	0.33	0.74	0.93	0.13	0.23
Grain Size (USCS)	Sandy Gravel, Little Silt, GP-GM	Silty Clay, Trace Sand, CL	Silty Clay, Trace Sand, CL	Sand, Trace Silt, SP	Silty Clay, Some Sand, Some Gravel, CL
Moisture Content (%)	NA	19.3	18.9	NA	12.5
Specific Gravity	2.70	2.75	2.75	2.70	2.78
Bulk Density (pounds/ft ³)	NA	131.2	130.2	NA	142.2

TABLE 7
Sample Results from Monitoring Wells
Completed in Glacial Sediments During the Lockformer Groundwater Investigation

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION										
	Class I	Class II	MW-101	MW-120	MW-123	MW-126	MW-401	MW-402	MW-500D	MW-501D	MW-502S	MW-504D	MW-508D
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	0.4950	0.0253	<0.005	<0.005	<0.005	<0.005	0.0062	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	0.0222	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	0.0287	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	20.900	0.0421	<0.005	<0.005	<0.005	0.4000	3.400	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	0.3710	<0.005	<0.005	<0.005	<0.005	0.0233	0.0734	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	0.0132	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	2.470	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	0.0263	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	38.800	<0.005	0.0063	<0.005	<0.005	0.0097	1.690	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	0.0414	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Detected

Exceeds Groundwater Remediation Objective

TABLE 7
Sample Results from Monitoring Wells
Completed in Glacial Sediments During the Lockformer Groundwater Investigation

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION										
	Class I	Class II	MW-513D	MW-514D	MW-515D	MW-515D Duplicate 2	MW-516D	MW-516D Duplicate 3	MW-517D	MW-521	MW-522	MW-1100S	MW-1101S
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	0.4560	0.4290	0.2310	0.2330	0.3460	<0.005	0.0570	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	0.0144	0.0143	0.0058	0.0061	0.0117	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	0.2390	0.2480	0.0223	0.0094	0.2730	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Detected

Exceeds Groundwater Remediation Objective

TABLE 7
Sample Results from Monitoring Wells
Completed in Glacial Sediments During the Lockformer Groundwater Investigation

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION										
	Class I	Class II	MW-1102S	MW-1102S Duplicate 1	MW-1103S	MW-1103M	MW-1104S	MW-1108S	MW-1109	MW-1110S	MW-1111S	MW-1112S	MW-1113S
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	0.0149	0.0152	<0.005	<0.005	<0.005	<0.005	0.0092	<0.005	<0.005	<0.005	0.379
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Detected

Exceeds Groundwater Remediation Objective

TABLE 7
Sample Results from Monitoring Wells
Completed in Glacial Sediments During the Lockformer Groundwater Investigation

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION								
	Class I	Class II	MW-1113M	MW-1113M <i>Duplicate 4</i>	MW-1114S	MW-1115	MW-1116	MW-1600S	MW-1601S	MW-1602S	MW-1602S <i>Duplicate 6</i>
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0061	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	0.0084	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	0.0913	0.0217	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742: Appendix B, Table E

Bold = Detected

Bold = Exceeds Groundwater Remediation Objective

TABLE 8
Sample Results
Single Packer Tests Performed During Drilling of the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO TIER 1 GROUNDWATER REMEDIALATION OBJECTIVES		SAMPLE LOCATION AND DEPTH (bgs)									
	Class I	Class II	MW-1100D		MW-1101D			MW-1102D				
			PT-1 66.0-71.0 FT	PT-2 67.0-74.0 FT	PT-1 74.3-81.3 FT	PT-2 84.4-91.4 FT	PT-3 89.4-96.4 FT	PT-1 80.0-87.0 FT	PT-2 90.0-97.0 FT	PT-3 100.0-107.0 FT	PT-4 109.0-116.0 FT	DUP-1/PT-4 109.0-116.0 FT
Acetone	0.7	0.7	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromodichloromethane	0.0002	0.0002	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromoform	0.001	0.001	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Carbon Tetrachloride	0.005	0.025	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorobenzene	0.1	0.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorodibromomethane	0.14	0.14	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloroethane	NE	NE	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloromethane	NE	NE	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloroethane	0.005	0.025	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1-Dichloroethene	0.007	0.035	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,2-Dichloroethene	0.07	0.2	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,2-Dichloroethene	0.1	0.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	0.005	0.025	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,3-Dichloropropane	0.001	0.005	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,3-Dichloropropane			<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.7	1.0	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Styrene	0.1	0.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2,2-Tetrachloroethane	NE	NE	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tetrachloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	1.0	2.5	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,1-Trichloroethane	0.2	1	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2-Trichloroethane	0.005	0.05	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trichloroethene	0.005	0.025	0.0011	0.0010	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

NS = Not Sampled due to dry conditions.

* = 35 IAC 742 Appendix B, Table E.

Bold = Detected

Bold = Exceeds Objective

TABLE 8
Sample Results
Single Packer Tests Performed During Drilling of the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO TIER 1 GROUNDWATER REMEDIALATION OBJECTIVES		SAMPLE LOCATION AND DEPTH (bgs)									
	Class I	Class II	MW-1102D				MW-1103D					
			PT-5 120.0-127.0 FT	PT-6 130.0-137.0 FT	PT-7 139.0-146.0 FT	PT-8 150.0-157 FT	PT-1 74.0-81.5 FT	PT-2 84.5-91.5 FT	PT-3 94.5-101.5 FT	PT-4 104.5-111.5 FT	PT-5 114.5-121.5 FT	PT-6 124.5-131.5 FT
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromodichloromethane	0.0002	0.0002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromoform	0.001	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Carbon Tetrachloride	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorobenzene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorodibromomethane	0.14	0.14	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloroethane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1-Dichloroethene	0.007	0.035	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,2-Dichloroethene	0.07	0.2	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,2-Dichloroethene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,3-Dichloropropane	0.001	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,3-Dichloropropane			<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.7	1.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Styrene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2,2-Tetrachloroethane	NE	NE	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tetrachloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	1.0	2.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,1-Trichloroethane	0.2	1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2-Trichloroethane	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trichloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

NS = Not Sampled due to dry conditions.

* = 35 IAC 742 Appendix B, Table E.

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 8
Sample Results
Single Packer Tests Performed During Drilling of the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO TIER 1 GROUNDWATER REMEDIALTION OBJECTIVES		SAMPLE LOCATION AND DEPTH (bgs)									
	Class I	Class II	MW-1103D				MW-1104D			MW-1105D		
			DUP-2/PT-6 124.5-131.5 FT	PT-7 134.5-141.5 FT	PT-8 144.5-151.5 FT	PT-9 147.0-154.0 FT	PT-1 74.5-81.5 FT	PT-2 84.5-91.5 FT	PT-3 92.0-99.5 FT	PT-1 80.0-88.0 FT	PT-2 92.0-99.0 FT	PT-3 97.0-104.0 FT
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Bromodichloromethane	0.0002	0.0002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Bromoform	0.001	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Carbon Tetrachloride	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Chlorobenzene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Chlorodibromomethane	0.14	0.14	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,2-Dichloroethane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,1-Dichloroethene	0.007	0.035	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Cis-1,2-Dichloroethene	0.07	0.2	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Trans-1,2-Dichloroethene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Cis-1,3-Dichloropropane	0.001	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Trans-1,3-Dichloropropane			<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.7	1.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Styrene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,1,2,2-Tetrachloroethane	NE	NE	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Tetrachloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Toluene	1.0	2.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,1,1-Trichloroethane	0.2	1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
1,1,2-Trichloroethane	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Trichloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	NS	NS	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	NS	NS	<0.0050	<0.0050	<0.0050

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

NS = Not Sampled due to dry conditions.

* = 35 IAC 742, Appendix B, Table E.

Detected = Detected

Exceeds Objective = Exceeds Objective

TABLE 8
Sample Results
Single Packer Tests Performed During Drilling of the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO TIER 1 GROUNDWATER REMEDIALATION OBJECTIVES		SAMPLE LOCATION AND DEPTH (bgs)								
	Class I	Class II	MW-1108D	MW-1110D	MW-1111D	MW-1112D	MW-1113D	MW-1114D	MW-1600D	MW-1601D	MW-1602D
			PT-1 86.0-96.0 FT	PT-1 56.0-66.0 FT	PT-1 56.0-66.0 FT	PT-1 55.5-66.0 FT	PT-1 66.0-76.0 FT	PT-1 77.0-82.0 FT	PT-1 102.0-112.0 FT	PT-1 84.0-92.0 FT	PT-1 67.0-77.0 FT
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromodichloromethane	0.0002	0.0002	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromoform	0.001	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Carbon Tetrachloride	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorobenzene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chlorodibromomethane	0.14	0.14	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloroethane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1-Dichloroethene	0.007	0.035	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,2-Dichloroethene	0.07	0.2	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,2-Dichloroethene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cis-1,3-Dichloropropane	0.001	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trans-1,3-Dichloropropane			<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.7	1.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Styrene	0.1	0.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2,2-Tetrachloroethane	NE	NE	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tetrachloroethene	0.005	0.025	<0.0050	0.007	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	1.0	2.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,1-Trichloroethane	0.2	1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,1,2-Trichloroethane	0.005	0.05	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Trichloroethene	0.005	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

NS = Not Sampled due to dry conditions.

* = 35 IAC 742, Appendix B, Table E.

= Detected

= Exceeds Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION								
	Class I	Class II	MW-1102D- SPT1	MW-1102D- SPT2	MW-1102D- SPT3	MW-1102D- SPT4	MW-1102D- SPT5	MW-1102D- SPT6	MW-1102D- SPT7	MW-1102D- SPT8	MW-1102D- SPT9
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.282
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Bold = Detected

Bold = Exceeds Groundwater Remediation Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION									
	Class I	Class II	MW-1103D- SPT10	MW-1103D- SPT11	MW-1103D- SPT12	MW-1103D- SPT13	MW-1103D- SPT14	MW-1103D- SPT15	MW-1103D- SPT16	MW-1103D- SPT17	MW-1103D- SPT18	
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742. Appendix B, Table E

Bold = Detected

Bold = Exceeds Groundwater Remediation Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION							
	Class I	Class II	MW-1100D- SPT19	MW-1101D- SPT20	MW-1101D- SPT21	MW-1101D- SPT22	MW-1104D- SPT23	MW-1104D- SPT24	MW-1104D- SPT25	MW-1105D- SPT26
Acetone	0.7	0.7	0.0125	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Bold = Detected

Bold = Exceeds Groundwater Remediation Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION									
	Class I	Class II	MW-1105D- SPT27	MW-1105D- SPT28	MW-1106D- SPT29	MW-1106D- SPT30	MW-1106D- SPT31	MW-1107D- SPT32	MW-1107D- SPT33	MW-1107D- SPT34	MW-1111D- SPT35	MW-1111D- SPT36
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	0.600	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Detected = Detected

Exceeds Groundwater Remediation Objective = Exceeds Groundwater Remediation Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION										
	Class I	Class II	MW-1113D-SPT37	MW-1113D-SPT38	MW-1113D-SPT39	MW-1110D-SPT40	MW-1110D-SPT41	MW-1108D-SPT42	MW-1108D-SPT43	MW-1112D-SPT44	MW-1112D-SPT45	MW-1114D-SPT46	MW-1114D-SPT46 (Duplicate #5)
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	0.0027	0.0013	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0013	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Bold = Detected

Bold = Exceeds Groundwater Remediation Objective

TABLE 9
Sample Results
Double Packer Tests Performed on the Bedrock Monitoring Wells

The Lockformer Company / Lisle, Illinois

COMPOUNDS	* TACO Tier 1 Groundwater Remediation Objectives		SAMPLE LOCATION										
	Class I	Class II	MW-1114D- SPT47	MW-1114D- SPT48	MW-1600D- SPT49	MW-1600D- SPT50	MW-1600D- SPT51	MW-1601D- SPT100	MW-1601D- SPT101	MW-1601D- SPT102	MW-1602D- SPT52	MW-1602D- SPT53	MW-1602D- SPT54
Acetone	0.7	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromodichloromethane	0.0002	0.0002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromoform	0.001	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromomethane	0.0098	0.049	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Butanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Carbon Disulfide	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Carbon Tetrachloride	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorobenzene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlorodibromomethane	0.14	0.14	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chloroform	0.0002	0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloromethane	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1,1-Dichloroethane	0.7	3.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloroethane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-Dichloroethene	0.007	0.035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,2-Dichloroethene	0.07	0.2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,2-Dichloroethene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,2-Dichloropropane	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cis-1,3-Dichloropropane	0.001	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trans-1,3-Dichloropropane			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	0.7	1.0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2-Hexanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
4-Methyl-2-Pentanone	NE	NE	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylene Chloride	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Styrene	0.1	0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-Tetrachloroethane	NE	NE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tetrachloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	1.0	2.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,1-Trichloroethane	0.2	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2-Trichloroethane	0.005	0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Trichloroethene	0.005	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vinyl Acetate	7	7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vinyl Chloride	0.002	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Xylenes (Total)	10	10	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

NOTES: All results reported in milligrams per liter (mg/L) or parts per million (ppm).

NE = Not Established

* = 35 IAC 742, Appendix B, Table E

Below = Detected

Below = Exceeds Groundwater Remediation Objective

TABLE 10
Lockformer Site Water Level Measurements

Monitoring Well ID	Top of Casing Elevation (msl)	**Top of Casing Elevation (Updated)	GW Elev. Aug-98 (msl)	GW Elev. Feb-99 (msl)	GW Elev. Mar-99 (msl)	GW Elev. Dec-99 (msl)	GW Elev. Nov-00 (msl)	GW Elev. 12/19/01 (msl)	GW Elev. 1/11/01 (msl)	GW Elev. 3/21/01 (msl)	GW Elev. 5/15/01 (msl)
BW-1	742.67	742.67						652.21	656.76	653.70	653.80
BW-2	689.16							652.76	652.51	654.06	654.25
BW-3	698.58							652.90	652.66	654.22	654.40
P-1	742.87							709.58	709.77	709.93	
P-2	689.25							668.37	668.16	668.05	
P-3	698.68							652.75	652.53	654.06	
MW-101	710.84		699.40	702.44	701.63		698.64	697.93	699.49	700.87	699.37
MW-104	710.12										
MW-105	710.90										
MW-120	707.84		675.04	675.19	674.86	674.74	668.50	668.30	668.18	669.32	668.43
MW-123	712.62		700.27	702.47	702.48	699.81	700.27	699.90	700.30	701.57	701.10
MW-126	706.30		655.80	655.00	654.91	652.92	653.60	653.73	655.26	655.18	654.72
MW-401	707.68	707.67	657.43	656.73	656.80	655.96	655.73	655.61	655.46	655.83	656.42
MW-402	700.71	700.74	655.56	657.71	655.81	654.20	654.86	654.17	653.79	655.20	655.94
MW-403	* 709.10		656.15	655.95	655.74	653.47					
MW-500S	703.29										
MW-500D	703.66			656.26	655.72	655.80	654.49	655.36	654.54	659.85	655.76
MW-501S	706.96					695.53	695.98	689.49	692.83		
MW-501D	707.34			656.84	656.79	655.23	655.42	655.19	655.01	656.03	656.47
MW-502S	712.38		699.40	701.28	701.93	703.73	707.06	707.25	706.66	706.86	707.89
MW-503S	* 712.07					693.39					
MW-504S	710.35										
MW-504D	711.51			656.11	657.39	653.87	654.81	655.42	658.64	656.48	655.93
MW-505S	707.00										
MW-506S	* 710.90										
MW-507S	711.59										
MW-508S	707.43										
MW-508D	707.50			658.30	656.54	653.90	655.00	654.79	654.48	655.47	655.88
MW-513D	706.90			656.15	655.76	653.49	654.67	654.01	655.52	655.54	655.73
MW-514D	701.19			657.29	655.78	653.71	654.95	654.14	653.76	655.80	655.93
MW-515D	703.07			656.57	655.94	653.52	654.81	654.53	657.00	659.62	655.87
MW-516D	700.59			656.59	655.94	653.61	654.75	654.07	658.68	658.67	655.87
MW-517D	709.66			656.36	655.77	653.67	654.51	653.97	656.53	659.85	655.75
MW-518D	* 690.65					653.46					
MW-519D	* 693.83					653.81					
MW-520	701.71						654.05	653.67	653.43	655.22	
MW-521	709.11						656.15	653.79	656.00	655.86	655.38
MW-522	706.29						654.26	653.76	653.51	655.51	655.81
MW-1100S	690.42										656.11
MW-1100D	690.90	690.91									654.74
MW-1101S	690.82										656.11
MW-1101D	691.27	691.26									654.73
MW-1102S	700.52										655.48
MW-1102D	700.57	700.56									654.68
MW-1103S	696.85										655.33
MW-1103M	696.82										654.72
MW-1103D	697.27	697.25									654.68
MW-1104S	698.84										655.14
MW-1104D	698.85	698.83									654.84
MW-1105D	702.89	702.88									654.87
MW-1106D	718.88	718.87									655.06
MW-1107D	710.03	710.05									654.87
MW-1108S	708.25										654.75
MW-1108D		707.32									
MW-1109	701.04	701.05									655.48
MW-1110S		681.90									
MW-1110D		681.94									
MW-1111S		680.22									
MW-1111D		680.17									
MW-1112S		681.32									
MW-1112D		680.75									
MW-1113S		692.11									
MW-1113M		692.40									
MW-1113D		692.11									
MW-1114S		698.87									
MW-1114D		699.10									
MW-1115		684.23									
MW-1116		682.50									
MW-1600S		729.08									
MW-1600D		729.09									
MW-1601S		703.97									
MW-1601D		703.82									
MW-1602S		686.61									
MW-1602D		687.05									
MW-1603		698.74									
MW-1604		690.29									
MW-1605		689.32									
SG-1	681.80									671.33	670.59
SG-2	676.50									666.99	666.44
SG-3	677.70									664.12	663.34
SG-4		680.6									
SG-5		671									
SG-6		668.88									
Katrine Well		708.78									
Finley Well		749.74									
Downer Dr. Well		754.96									
67th St. Well		751.09									
71st St. Well		784.76									
63rd St. Well		739.55									

NOTES: msl = mean sea level
GW = Ground Water
Shaded cells = Not Applicable
Depth to groundwater measured from the top of the well casing.
* Top of casing elevations calculated using average difference observed between Carlson's relative elevation measurements and the January 5, 2001 survey.
** Updated top of casing elevations should be used to determine groundwater elevations after 5/15/2001.

TABLE 10
Lockformer Site Water Level Measurements

Monitoring Well ID	Top of Casing Elevation (msl)	**Top of Casing Elevation (Updated)	GW Elev. 6/27/01 (msl)	GW Elev. 7/12/01 (msl)	GW Elev. 8/10/01 (msl)	GW Elev. 9/10/01 (msl)	GW Elev. 9/20/01 (msl)	GW Elev. 10/17/01 (msl)	GW Elev. 11/30/01 (msl)	GW Elev. 2/14/02 (msl)	GW Elev. 3/20/02 (msl)
BW-1	742.67	742.67	653.27	652.76	652.66	652.73	652.64	654.20	653.78	652.65	653.58
BW-2	689.16		653.64	653.25	653.10	653.14	653.15	654.81	654.18	653.06	653.98
BW-3	698.58		653.74	653.37	653.22	653.29	653.31	654.95	654.31	653.20	654.12
P-1	742.87										
P-2	689.25										
P-3	698.68										
MW-101	710.84		698.57		698.51		698.67	699.78	698.76	698.49	700.23
MW-104	710.12										
MW-105	710.90										
MW-120	707.84		660.08		666.12		666.05	666.83	666.89	672.11	670.03
MW-123	712.62		700.19		700.17		700.56	701.55	700.47	700.20	701.32
MW-126	706.30		654.08		653.53		653.50	655.16	654.60	653.47	654.37
MW-401	707.68	707.67	656.56		656.31		655.99	656.02	656.45	655.99	655.95
MW-402	700.71	700.74	655.31		654.79		654.93	657.29	655.83	654.60	655.37
MW-403	* 709.10										
MW-500S	703.29										
MW-500D	703.66		655.23		654.63		654.39	656.08	655.57	654.36	655.08
MW-501S	706.96										
MW-501D	707.34		656.41		655.96		655.58	656.06	656.23	655.51	655.86
MW-502S	712.38		704.09		705.79		707.22	706.80	709.36	706.44	705.61
MW-503S	* 712.07										
MW-504S	710.35										
MW-504D	711.51		655.45		654.88		654.69	655.62	655.72	654.57	655.13
MW-505S	707.00										
MW-506S	* 710.90										
MW-507S	711.59										
MW-508S	707.43										
MW-508D	707.50		655.62		655.04		654.74	655.13	655.63	654.55	654.97
MW-513D	706.90		655.11		654.55		654.71	656.29	655.53	654.39	655.09
MW-514D	701.19		655.27		654.79		655.18	656.91			
MW-515D	703.07		655.24		654.70		654.78	657.05	655.69	654.52	655.27
MW-516D	700.59		655.24		654.65		654.88	657.36	655.72	654.50	655.36
MW-517D	709.66		655.18		654.62		654.41	656.36	655.64	654.38	655.14
MW-518D	* 690.65										
MW-519D	* 693.83										
MW-520	701.71										
MW-521	709.11		654.91		654.31		654.11	655.11	655.30	654.11	654.93
MW-522	706.29		655.35		654.26		654.18	655.12	655.70	654.14	655.13
MW-1100S	690.42		655.39		654.98		655.60	658.09	655.92	654.76	655.63
MW-1100D	690.90	690.91	654.08	653.66	653.54	653.56	653.54	655.15	654.57	653.47	654.40
MW-1101S	690.82		655.39		654.95		655.62	657.72	655.91	654.80	655.64
MW-1101D	691.27	691.26	654.06	653.64	653.52	653.54	653.54	655.12	654.55	653.46	654.38
MW-1102S	700.52		654.90		654.31		654.11	656.37	655.27	654.36	655.22
MW-1102D	700.57	700.56	654.05	653.65	653.55	653.58	653.54	655.27	654.55	653.49	654.37
MW-1103S	696.85		654.79		654.23		654.07	656.07	654.62	654.30	655.11
MW-1103M	696.82		654.11		653.57		653.62	654.84	655.09	653.51	654.41
MW-1103D	697.27	697.25	654.04	653.64	653.54	653.55	653.61	655.65	654.56	653.48	654.35
MW-1104S	698.84		654.66		654.08		653.93	655.42	654.98	653.99	654.84
MW-1104D	698.85	698.83	654.20	653.79	653.67	653.72	653.73	655.42	654.69	653.60	654.52
MW-1105D	702.89	702.88	654.26	653.85	653.73	653.77	653.79	655.48	654.73	653.64	654.57
MW-1106D	718.88	718.87	654.46	654.03	653.91	653.96	653.96	655.70	664.88	653.80	654.76
MW-1107D	710.03	710.05	654.32	653.90	653.78	653.81	653.78	655.48	654.83	653.68	654.54
MW-1108S	708.25		654.16		653.58	653.60	653.58	655.24	654.66	653.51	654.41
MW-1108D		707.32						655.63	654.88	653.76	654.62
MW-1109	701.04	701.05	654.91		654.32		654.10	656.29	655.24	654.35	655.20
MW-1110S		681.90					654.03	655.82	654.97	653.86	654.82
MW-1110D		681.94				653.97	652.20	655.83	654.95	653.83	654.83
MW-1111S		680.22					654.01	655.90	654.89	653.81	654.80
MW-1111D		680.17				653.94	653.98	655.75	654.93	653.78	654.76
MW-1112S		681.32					654.18	655.33	655.28	654.17	655.00
MW-1112D		680.75				653.86	653.90	655.64	654.91	653.74	654.69
MW-1113S		692.11					653.52	655.30	654.58	653.54	654.54
MW-1113M		692.40					653.45	655.07	654.51	653.44	655.32
MW-1113D		692.11					653.46	655.08	654.51	653.44	654.54
MW-1114S		698.87					653.98	655.76	654.89	653.85	654.76
MW-1114D		699.10					653.98	655.74	654.91	653.82	654.76
MW-1115		684.23							654.34	653.24	654.17
MW-1116		682.50							654.34	652.55	654.20
MW-1600S		729.08							652.04	650.76	651.58
MW-1600D		729.09							651.91	650.63	651.66
MW-1601S		703.97							653.16	651.65	
MW-1601D		703.82							652.69	651.29	
MW-1602S		686.61							654.00	652.77	653.60
MW-1602D		687.05							653.68	652.42	653.33
MW-1603		698.74							654.24	653.23	654.20
MW-1604		690.29							654.15	652.99	653.92
MW-1605		689.32							654.07	652.92	653.80
SG-1	681.80		670.41		670.51	670.66	670.94	670.98	670.85	670.71	670.60
SG-2	676.50		666.32	666.27	666.41	666.51	666.72	666.93	666.83	666.65	666.57
SG-3	677.70		663.20	663.04	663.37	663.48	663.73	663.71	663.64	663.46	663.42
SG-4		680.6		664.34	664.53	664.74	666.46	665.61	665.20	664.64	664.61
SG-5		671		656.80	656.96	657.14	658.72	658.09	657.42	657.02	657.02
SG-6		668.88		651.93	652.40	652.71	654.98	654.26	653.16	652.68	652.47
Katrine Well		708.78		648.49		650.12			649.81	648.19	649.14
Finley Well		749.74		669.08		667.20			670.35	669.78	671.10
Downer Dr. Well		754.96		652.42		651.94			653.41	652.43	652.56
67th St. Well		751.09		641.35		640.86			642.19	641.34	641.15
71st St. Well		784.76		641.86		641.54			643.09	641.83	642.09
63rd St. Well		739.55				646.77			647.12	645.99	646.01

NOTES: msl = mean sea level
GW = Ground Water
Shaded cells = Not Applicable
Depth to groundwater measured from the top of the well casing.
* Top of casing elevations calculated using average difference observed between Carlson's relative elevation measurements and the January 5, 2001 survey.
** Updated top of casing elevations should be used to determine groundwater elevations after 5/15/2001.

TABLE 11
Soil Analytical Results
1500 Series Soil Borings Performed in Area 3

The Lockformer Company / Lisle, Illinois

Sample ID	Depth (bgs)	Material Description ^b	Constituents and Objectives ^a					
			1,1,1-TCA	1,1-DCE	Trans-1,2-DCE	Cis-1,2-DCE	TCE	PCE
			2,000	60	700	400	60	60
CSB-1500	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1501	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1502	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	16'-18'	GM	<150	<50	<50	<50	<50	<50
CSB-1503	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
CSB-1504	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1505	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
CSB-1506	2'-4'	CL	<150	<50	<50	<50	<50	<50
CSB-1507	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1508	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1509	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1510	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1511	2'-4'	CL	<150	<50	<50	<50	<50	<50
CSB-1512	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1513	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1514	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GC	<150	<50	<50	<50	<50	<50
CSB-1515	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1527	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
CSB-1528	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1529	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	331	<50
CSB-1530	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-15.5'	CL	<150	<50	<50	<50	<50	<50

NOTES:

^a = Most conservative value contained in 35 IAC 742 Appendix B, Tables A and B.

^b = Unified Soil Classification System (USCS).

Results in micrograms per kilogram or parts per billion (ppb).

 = Exceeds objective

 = indicates analysis conducted at First Environmental Laboratories, Inc.

TABLE 11
Soil Analytical Results
1500 Series Soil Borings Performed in Area 3

The Lockformer Company / Lisle, Illinois

Sample ID	Depth (bgs)	Material Description ^b	Constituents and Objectives ^a					
			1,1,1-TCA	1,1-DCE	Trans-1,2-DCE	Cis-1,2-DCE	TCE	PCE
			2,000	60	700	400	60	60
CSB-1542	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	GC	<150	<50	<50	<50	<50	<50
CSB-1543	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	GC	<150	<50	<50	<50	<50	<50
CSB-1544	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
CSB-1545	2'-4'	CL	<150	<50	<50	<50	<50	<50
	6'-8'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GC	<150	<50	<50	<50	<50	<50
CSB-1546	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	SC	<150	<50	<50	<50	<50	<50
CSB-1547	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
CSB-1548	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	SC	<150	<50	<50	<50	<50	<50
CSB-1549	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	SC	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	18	<50
CSB-1550	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1551	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	SC	<150	<50	<50	<50	27	<50
CSB-1552	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
CSB-1553	2'-4'	SC	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
CSB-1554	2'-4'	GM	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	15
	20'-22'	GM	<150	<50	<50	<50	<50	<50
	26'-28'	GM	<150	<50	<50	<50	<50	<50
CSB-1555	2'-4'	CL	<150	<50	<50	<50	11	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50

NOTES:

^a = Most conservative value contained in 35 IAC 742 Appendix B, Tables A and B.

^b = Unified Soil Classification System (USCS).

Results in micrograms per kilogram or parts per billion (ppb).

Exceeds objective

= indicates analysis conducted at First Environmental Laboratories, Inc.

TABLE 11
Soil Analytical Results
1500 Series Soil Borings Performed in Area 3

The Lockformer Company / Lisle, Illinois

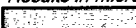
Sample ID	Depth (bgs)	Material Description ^b	Constituents and Objectives ^a					
			1,1,1-TCA	1,1-DCE	Trans-1,2-DCE	Cis-1,2-DCE	TCE	PCE
			2,000	60	700	400	60	60
CSB-1556	2'-4'	GM	<150	<50	<50	<50	26	<50
	8'-10'	GM	<150	<50	<50	<50	30	<50
	14'-16'	GM	<150	<50	<50	<50	42	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
CSB-1557	2'-4'	GM	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	42	<50
CSB-1558	2'-4'	GM	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	22'-24'	CL	<150	<50	<50	<50	310	<50
CSB-1559	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
CSB-1560	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
CSB-1561	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	21
	14'-16'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	173	<50
CSB-1562	2'-4'	CL	<150	<50	<50	<50	<50	<50
	10'-12'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	64	29
	16'-18	CL	<150	<50	<50	<50	379	326
	22'-24'	CL	<150	<50	<50	<50	1,004	827
	22'-24'	CL	<5	<5	<5	<5	196	188
	26'-28'	GM	<150	<50	<50	<50	1,042	404
	26'-28'	GM	<5	<5	<5	<5	80.2	55.7
	30'-32'	CL	<150	<50	<50	<50	551	166
CSB-1563	2'-4'	CL	<150	<50	<50	<50	<50	<50
	6'-8'	GM	<150	<50	<50	<50	<50	<50
CSB-1564	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	GM	<150	<50	<50	<50	110	<50
	18'-20'	GM	<150	<50	<50	<50	279	<50
	20'-22	GM	<150	<50	<50	<50	16	<50
	22'-24'	SP	<150	<50	<50	<50	758	58
	24'-26'	GM	<150	<50	<50	<50	41	<50
	26'-28'	GM	<150	<50	<50	<50	445	43
CSB-1565	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	18'-20'	GM	<150	<50	<50	<50	418	81
	22'-24	SP	<150	<50	<50	<50	139	31

NOTES:

^a = Most conservative value contained in 35 IAC 742 Appendix B, Tables A and B.

^b = Unified Soil Classification System (USCS).

Results in micrograms per kilogram or parts per billion (ppb).

 = Exceeds objective

 = indicates analysis conducted at First Environmental Laboratories, Inc.

TABLE 11
Soil Analytical Results
1500 Series Soil Borings Performed in Area 3

The Lockformer Company / Lisle, Illinois

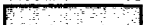
Sample ID	Depth (bgs)	Material Description ^b	Constituents and Objectives ^a					
			1,1,1-TCA	1,1-DCE	Trans-1,2-DCE	Cis-1,2-DCE	TCE	PCE
			2,000	60	700	400	60	60
CSB-1566	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	18'-20'	GM	<150	<50	<50	<50	466	90
	20'-22'	GM	<150	<50	<50	<50	<50	<50
	22'-24'	GM	<150	<50	<50	<50	58	<50
CSB-1567	6'-8'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	16'-18'	GM	<150	<50	<50	<50	86	<50
	18'-20'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
	22'-24'	GM	<150	<50	<50	<50	<50	<50
CSB-1568	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	SM	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	73	<50
CSB-1569	6'-8'	GM	<150	<50	<50	<50	<50	<50
	10'-12'	GM	<150	<50	<50	<50	<50	<50
	16'-18'	GM	<150	<50	<50	<50	269	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
CSB-1570	22'-24'	CL	<150	<50	<50	<50	<50	<50
	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	GM	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	18	<50
CSB-1571	22'-24'	SP	<150	<50	<50	<50	34	<50
	4'-6'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<150	<50	<50	<50	<50	<50
	20'-22'	GM	<5	<5	<5	<5	<5	<5
	22'-24'	GM	<150	<50	<50	<50	<50	<50
CSB-1572	22'-24'	GM	<5	<5	<5	<5	<5	<5
	26'-28'	GM	<150	<50	<50	<50	<50	<50
	2'-4'	CL	<150	<50	<50	<50	<50	<50
	8'-10'	CL	<150	<50	<50	<50	<50	<50
	14'-16'	CL	<150	<50	<50	<50	<50	<50
	20'-22'	CL	<150	<50	<50	<50	189	<50
	20'-22'	CL	<5	<5	<5	<5	26.8	<5
CSB-1573	26'-28'	GM	<150	<50	<50	<50	<50	<50
	26'-28'	GM	<5	<5	<5	<5	<5	<5
	14'-16'	GM	<5	<5	<5	<5	8	<5
	18'-20'	GM	<5	<5	<5	<5	12.3	<5
	20'-22'	GM	<5	<5	<5	<5	13.8	<5
	22'-24'	GM	<5	<5	<5	<5	15.2	<5

NOTES:

^a = Most conservative value contained in 35 IAC 742 Appendix B, Tables A and B.

^b = Unified Soil Classification System (USCS).

Results in micrograms per kilogram or parts per billion (ppb).

 = Exceeds objective

 = indicates analysis conducted at First Environmental Laboratories, Inc.

TABLE 12
Groundwater Analytical Results
Area 3

The Lockformer Company / Lisle, Illinois

Sample ID	Relative Depth	Constituents and Objectives ^a					
		1,1,1-TCA	1,1-DCE	Trans-1,2-DCE	Cis-1,2-DCE	TCE	PCE
		200	7	100	70	5	5
CSB-1548	Shallow	<3	<1	<1	<1	15	<1
CSB-1549	Shallow	<3	<1	<1	<1	8	<1
CSB-1550	Shallow	<3	<1	<1	<1	23	<1
CSB-1551	Shallow	<3	<1	<1	<1	3	<1
CSB-1552	Shallow	<3	<1	<1	<1	12	<1
CSB-1553	Deep	<3	<1	<1	<1	42	<1
CSB-1554	Deep	<3	<1	<1	<1	19	<1
CSB-1555	Deep	<3	<1	<1	<1	4	<1
CSB-1556	Deep	<3	<1	<1	<1	13	2
CSB-1557	Deep	<3	<1	<1	<1	43	6
CSB-1558	Deep	<3	<1	<1	<1	9	<1
CSB-1559	Deep	<3	<1	<1	<1	15	<1
CSB-1560	Deep	<3	<1	<1	<1	11	<1
CSB-1561	Deep	<3	<1	<1	<1		<1
CSB-1562	Deep	<3	<1	<1	2		14
CSB-1562	Deep	<5	<5	<5	<5		24.4
CSB-1564	Deep	<3	<1	<1	4		3
CSB-1565	Deep	<3	<1	<1	4		4
CSB-1566	Deep	<3	<1	<1	4		5
CSB-1567	Deep	<3	<1	<1	4		2
CSB-1568	Deep	<3	<1	<1	1		1
CSB-1569	Deep	<3	<1	<1	<1		1
CSB-1570	Deep	<3	<1	<1	<1		1
CSB-1573	Deep	<5	<5	<5	<5	50.5	<5

NOTES:

a = TACO Tier 1 Groundwater Remediation Objectives for the Groundwater Component of the Class I Groundwater Ingestion Route established in 35 IAC 742 Appendix B. Table E.

Results in micrograms per liter or parts per billion (ppb).

Shallow = approximately 10 to 12 feet below ground surface (bgs)

Deep = approximately 24 to 28 feet bgs

 = indicates analysis conducted at First Environmental Laboratories, Inc.


 = exceeds objective

TABLE 13
First Environmental Laboratories Detection and Reporting Limits
VOCs -- Target Compound List -- Method 8260B

The Lockformer Company / Lisle, Illinois

Chemical Name	Water (µg/L)		Soil (µg/Kg)		Extractable Soil (µg/kg)	
	MDL	RQL	MDL	RQL	MDL	RQL
1,1,1-Trichloroethane	0.40	1.0	1.21	5.0	0.40	100
1,1,2,2-Tetrachloroethane	0.22	1.0	0.45	5.0	0.22	100
1,1,2-Trichloroethane	0.24	1.0	0.48	5.0	0.24	100
1,1-Dichloroethane	0.26	1.0	1.02	5.0	0.26	100
1,1-Dichloroethene	0.30	1.0	1.72	5.0	0.30	100
1,2-Dichlorobenzene	0.42	1.0	0.49	5.0	0.42	100
1,2-Dichloroethane	0.53	1.0	0.89	5.0	0.53	100
1,2-Dichloropropane	0.42	1.0	0.81	5.0	0.42	100
1,3-Dichlorobenzene	0.42	1.0	0.69	5.0	0.42	100
1,4-Dichlorobenzene	0.24	1.0	0.60	5.0	0.24	100
2-Butanone	1.02	5.0	1.16	10	1.02	100
2-Hexanone	0.39	5.0	0.55	10	0.39	100
4-Methyl-2-Pentanone	0.56	5.0	0.76	10	0.56	100
Acetone	2.01	5.0	1.87	10	2.01	100
Benzene	0.27	1.0	0.81	5.0	0.27	100
Bromodichloromethane	0.80	1.0	0.64	5.0	0.80	100
Bromoform	0.42	1.0	0.30	5.0	0.42	100
Bromomethane	1.05	2.0	1.03	10	1.05	100
Carbon Disulfide	0.31	1.0	1.59	5.0	0.31	100
Carbon Tetrachloride	0.48	1.0	1.40	5.0	0.48	100
Chlorobenzene	0.26	1.0	0.72	5.0	0.26	100
Chloroethane	0.82	2.0	1.17	10	0.82	100
Chloroform	0.42	1.0	0.99	5.0	0.42	100
Chloromethane	0.48	2.0	1.09	10	0.48	100
cis-1,2-Dichloroethene	0.31	1.0	0.60	5.0	0.31	100
cis-1,3-Dichloropropene	0.24	1.0	0.53	5.0	0.24	100
Dibromochloromethane	0.80	1.0	0.40	5.0	0.80	100
Ethylbenzene	0.17	1.0	0.88	5.0	0.17	100
Total xylenes	0.23	3.0	1.65	15	0.23	100
Methylene Chloride	0.49	1.0	1.23	5.0	0.49	100
Styrene	0.15	1.0	0.53	5.0	0.15	100
Tetrachloroethene	0.69	1.0	1.23	5.0	0.69	100
Toluene	0.23	1.0	0.79	5.0	0.23	100
trans-1,2-Dichloroethene	0.38	1.0	1.22	5.0	0.38	100
trans-1,3-Dichloropropene	0.20	1.0	0.28	5.0	0.20	100
Trichloroethene	0.35	1.0	1.01	5.0	0.35	100
Vinyl Acetate	0.72	1.0	0.83	5.0	0.72	100
Vinyl Chloride	0.34	2.0	1.53	10	0.34	100

NOTES:

MDL = Method Detection Limit (as defined and calculated in 40CFR, Part 136, Appendix B). Based on MDL Study Final Reports provided in Appendix B.

RQL = Reportable Quantitation Limit

Soil MDLs and RQLs listed above are based upon 100% solids. Sample results will be elevated due to the percent moisture present in the sample.

TABLE 14
Instrument Calibration Frequency
First Environmental Laboratories, Inc.

The Lockformer Company / Lisle, Illinois

Instrument	Method Reference	# Standards Initial Calibration	Acceptance/Rejection Criteria Initial Calibration	Frequency of Calibration	Frequency of Initial Calibration Verification	Acceptance/Rejection Criteria Initial Calibration Verification	Frequency of Continuing Calibration Verification	Acceptance/Rejection Criteria Continuing Calibration Verification
GC/MS volatiles	SW-846 8260B	5-8	% RSD (CCC) <30% 1,1-dichloroethene chloroform 1,2-dichloropropane toluene ethyl benzene vinyl chloride RF (SPCC) chloromethane (0.1) 1,1-dichloroethane (0.1) bromoform (0.1) 1,1,2,2-tetrachloroethane (0.3) chlorobenzene (0.3)	As needed	As needed	CCC <20% D	Every 12 hours	CCC %D <20% Same SPCC criteria as initial calibration

TABLE 15
Summary of Analytical Procedures

The Lockformer Company / Lisle, Illinois

Analyte		Laboratory SOP No.	Method No.
Matrix:	WATER Volatile Organics	First Environmental SOP 204	SW-846 Method 8260B
Matrix:	SOIL Volatile Organics	First Environmental SOP 204	EPA Method 5035/ SW-846 Method 8260B

TABLE 16
Laboratory Preventative Maintenance and Schedules

The Lockformer Company / Lisle, Illinois

INSTRUMENT	MAINTENANCE PROCEDURES/SCHEDULE	SPARE PARTS IN STOCK
Gas Chromatograph Spectrometer (GC/MS)	1. Replace pump oil as needed.	1. Syringes
	2. Disassemble and clean "source" as needed.	2. Septa
	3. Change septa weekly or as often as needed.	3. Various electronic and mechanical components
	4. Replace electron multiplier and filaments as often as needed.	4. Glass jet separator
	5. Replace GC injector glass liner weekly or as often as needed.	5. GC columns
	6. Replace GC column as needed.	6. Glass liner
	7. Check to ensure that gas supply is sufficient for the day's activity.	7. Rough pump
Gas Chromatograph	1. Change septa weekly or as often as needed.	1. Syringes
	2. Replace GC injector glass liner weekly or as often as needed.	2. Septa
	3. Replace GC column as needed.	3. Detectors
	4. Clean/replace GC detector as needed.	4. Glass liner
	5. Check to ensure that gas supply is sufficient for the day's activity.	5. GC columns
Purge and Trap Sample Concentrator	1. Replace trap as needed.	1. Spare traps
	2. Decontaminate system after running high concentration samples or as required components by blank analysis.	2. Spare sparger
	3. Leak-check system often as needed.	3. Various electronic and mechanical components
	4. Check to ensure the gas supply is sufficient for the day's activity.	4. Plumbing supplies, valves, tubing fitting, & transfer lines

TABLE 17
Summary of Investigation Sampling and Analyses To Be Performed

The Lockformer Company / Lisle, Illinois

Sampling Location	No. of Borings ^a	No. of Borings Completed as Monitoring Wells	Soil	Ground Water ^b	Analyses ^c	Field QC					Comments
			No. of Samples	No. of Samples		Duplicate	MS/MSD	Trip Blanks	Field Blanks	Equipment Rinse Blank	
Former Vapor Degreaser Area (1700-Series Soil Borings)	6	-	24	-	VOCs	3	2			2	See Section 1.5.1.1 (Figure 20)
Mass Waste Sand and Gravel Unit in Areas 1 and 2 (1800-Series Soil Borings)	15	-	45	-	VOCs	5	3			3	See Sections 1.5.1.2 and 1.5.2.2 (Figure 21)
Additional Surface Drainage Way Sampling (1900-Series Soil Borings)	26	-	96	10	VOCs	11	7	3	1	6	See Section 1.5.4 (Figure 25)
Surficial Silty Clay Till/Fill in Areas 1 and 2 (2000-Series Soil Borings)	45	-	180	-	VOCs	18	11			10	See Sections 1.5.1.1 and 1.5.2.1 (Figure 19)
Additional Soil and Groundwater Investigations in Area 3 (2100-Series Soil Borings)	26	10	51	37	VOCs	9	6	4	2	5	See Section 1.5.3 (Figure 22)

NOTES:

^a = The number of borings and samples are based on the assumption that the sampling grids will not expand.

^b = Groundwater sampling includes monitoring of pH, temperature, conductivity, and turbidity

^c = Method 8260B will be used for VOC analyses and Method 5035 will be used for soil sample collection/preservation

TABLE 18
Sample Holding Times, Containers, Preservatives, and Volume Requirements

The Lockformer Company / Lisle, Illinois

PARAMETER	METHOD	MATRIX	HOLDING TIME (1)	CONTAINER	PRESERVATIVE	MINIMUM VOLUME REQUIRED
Volatile Organics	5030/8260B	Water	14 days	3-40mL VOA Vial	HCl to pH <2, no headspace Maintained at 4 ± 2 Degrees Celcius	120 mL
	5035/8260B	Soil	14 days	4-40mL vials w/ magnetic stir bars 1-40 mL vial 1-2 oz glass jar	5 mLs of NaHSO ₄ in 2 vials w/ stir bars 5 mLs of Methanol in 1 vial w/o stir bar 5 mLs of deionized water in 2 vials w/ stir bars Maintained at 4 ± 2 Degrees Celcius	25 grams for vials 1 oz in jar

NOTES:

(1) Holding time measured from time of sampling

ATTACHMENT A

FIELD STANDARD OPERATING PROCEDURES

<u>SOP DESCRIPTION</u>	<u>SOP NO.</u>
Records, Reports, Field Reporting, Documentation, and Record Retention.....	110
Borehole Logging and Material Classification.....	120
Soil Sampling and Rock Coring.....	200
Well Installation	210
Grouting Procedures.....	211
Well Development.....	212
Groundwater and LNAPL Level Measurements	220
Air Quality Monitoring.....	310
Field Measurements.....	320
Vapor Headspace Screening.....	330
Surface Water, Sediment, Sludge, and Waste Sampling.....	400
Groundwater Sampling.....	410
Equipment Decontamination	500
Sample Containers, Preservation, and Holding Time	910
Sample Classification, Storage, Packaging, and Shipment	911
Sample Control and Custody Procedures	912
Field Quality Assurance Samples.....	920
Control, Calibration, and Maintenance of Measurement and Test Equipment.....	930

Standard Operating Procedure No. 110

RECORDS, REPORTS, FIELD REPORTING, DOCUMENTATION, AND RECORD RETENTION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 110 describes the guidelines for reporting significant events, procedures, observations, and data acquisition during field operations as described in the Work Plan or other specifications. The purpose of field reporting and documentation protocol is to reconstruct events and to provide testimony during legal proceedings.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. All field activities, data, and other significant occurrences at the site during field operations shall be documented in a bound field logbook with numbered pages or on a field report form. Subcontractors will provide similar documentation to the project manager or site manager.
- B. Field measurements should be recorded on standard forms to facilitate the collection of field data during field operations.
- C. The information in the logbook or standard data forms can be transcribed or duplicated. However, the bound logbook record will take official precedence over transcribed or duplicate records, if the same data (whether conflicting or agreeing) is contained in both.
- D. The field logbook (and/or field report form) shall contain the following documentation:
 - 1. Facility name and address
 - 2. Date
 - 3. Brief description of daily field activities
 - 4. Names of project team members and subcontractors

5. Weather conditions
 6. Planned levels of personnel protection
 7. Time and description of field activities
 8. Instrument calibration results and maintenance procedures
 9. Field instrument measurements and results
 10. Decontamination of personnel and equipment
 11. Sample locations
 12. Sample methods
 13. Analytical parameters and sample containers
 14. Time of sample collection
 15. Sketch of sample location
 16. Sample packaging and shipping
 17. Visitors and deliveries
 18. Exposure incidents and accidents (see Site Health and Safety Plan for requirements)
 19. Field audits and corrective action
- E. Documentation should be consistent with the requirements of the SOPs and Quality Assurance Project Plan (QAPP) for collecting samples, calibrating equipment, preserving samples, packaging samples, and tracking sample shipments. In the event this or other SOPs differ, the requirements of the QAPP will take precedence.
- F. All entries in the field logbook (or field report form) should be legible and recorded in permanent ink. Each page of the logbook should be signed and dated. All field documents should be protected against contamination (soiling and smudging) to the extent possible.
- G. Photocopies of all field forms should be made daily and maintained in a duplicate file onsite. Copies should be stamped, clearly marking the copy as a copy.

- H. Records and documents received by/or originated at the site shall be maintained in an orderly fashion. This information shall be available for audit reviews by appropriate Clayton and outside parties.
- I. At the termination of the contract, or at designated periods during the project, records and documents shall be disposed, filed, or distributed in accordance with applicable codes and/or contract requirements unless otherwise stipulated by code or contract. Site records, logbooks, and field reports will be maintained by Clayton for a minimum of 10 years after the completion of the Work Plan.

2.2 FIELD DOCUMENTS AND THEIR USE

2.2.1 Field Logbook

- A. Field logbooks (or field report forms) will provide the documentation of all field activities performed by field personnel and subcontractors. Each entry should be recorded legibly and in permanent ink. The entries should contain accurate and complete field documentation of the specific field activities. The logbook (or field report form) should contain only facts and observations that pertain to the field activities and objectives of the Work Plan. Each page should be numbered, dated, and signed by all personnel making entries on that page. Under no circumstances will pages be removed from the logbook or report form.
- B. General information that should be documented in the field logbook(s)/report form includes, but is not limited to, the following:
 - 1. Project name and number.
 - 2. Facility name, address, contact person(s), and telephone number, if available.
 - 3. Directions to the site/facility.
- C. Specific information that should be documented in the field logbook/report form includes, but is not limited to:
 - 1. Brief description of planned field activities.
 - 2. Name of project team members and subcontractors onsite.
 - 3. Weather conditions.

4. Detailed description of health and safety related activities at the site, including use of personal protective equipment and air monitoring data.
 5. Notation of time and chronological summary of field activities and events.
 6. Calibration results and maintenance procedures for field instruments used.
 7. Field measurements.
 8. Sample collection information including sample number, location, descriptions, field measurements, analytical parameters, and sample containers, as described for specific activities presented in the SOPs for sampling and chain of custody procedures.
 9. Identification of major equipment used onsite.
 10. Documentation of personnel and equipment decontamination.
 11. Photograph information and descriptions.
 12. Signatures of individuals making entries.
- D. Project field logbooks/report forms should generally not contain personnel records or data not relevant to the work being performed at the site.

2.2.2 Field Data Collection Forms

2.2.2.1 *Groundwater Sampling Forms*

- A. Documentation of well purging activities prior to groundwater sampling may be kept on forms as a comprehensive means to record well purging activities.
- B. The forms used should reflect the site-specific data required in the Work Plan or the SOP addressing that specific activity.
- C. The information recorded on this form should be briefly described in the field logbook by the field team leader.

- D. The well development/groundwater sampling form is referenced in SOP No. 410 for groundwater sampling, and should be used when appropriate.
- E. The form should contain information and data including project name and number; rig-up and down time; well headspace reading; name of driller and geologist/hydrogeologist; development or purge method; fluid level measurements; depth to sediment and well casing; standing water volume; volume and number of well volumes removed; and water quality parameter measurements.

2.2.2.2 *Water/Product Level Measurements*

- A. Documentation of water/product level measurements may be kept on forms as a comprehensive means to record fluid level measurements in wells.
- B. The forms used should reflect the site-specific data required in the Work Plan or the SOP addressing that specific activity.
- C. The information recorded on this form should be briefly described in the field logbook by the field team leader.
- D. The water/product level form is referenced in SOP No. 220 and should be used when appropriate.
- E. The form should contain information and data including the measurement location; measuring device; measurement point elevation; depth to water and product; elevation of water and product; and any comments.

2.2.3 Chain of Custody Forms

- A. A chain of custody form shall accompany each batch of samples transported from the site. Forms will contain the minimum information specified in SOP No. 912.
- B. If samples within a given shipment are to be separated at some point before their final disposition, then separate chain of custody forms will be provided for each separate group of samples.

2.2.4 Visitor's Log

- A. Names of people visiting the site, arrival and departure times and dates, and nature of their activities will be documented in the field logbook. It should be noted by the site manager whether the visitor remained in the clean zone of the site or not. Visitors will not be allowed in the work areas unless they have completed Health and Safety training and have reviewed the SHSP. All visitors that enter the work zone should have the appropriate personal protective equipment.
- B. Unauthorized persons will not be permitted onsite during any field activities. Unauthorized visitors should be reported to the site manager or senior site authority for proper action.

2.2.5 Daily Field Report

A summary of daily field activities should be kept to report the progress of field operations for that day. Information that should be summarized includes, but is not limited to, the following:

- 1. Summary of all field activities.
- 2. Sampling locations worked.
- 3. Number of samples taken at each sample location.
- 4. Identification of problems, downtime, and corrective action taken.
- 5. Summary of weather and weather impacts.
- 6. Personnel and visitors recorded onsite that day.
- 7. Change in the work scope or methodology initiated in the field.
- 8. Changes or additional work or specification initiated by the client.

2.2.6 Daily Sheets

Daily sheets should include the following information:

- A. List of equipment used and supplies purchased should be recorded in the daily equipment sheets.
- B. Clayton and subcontractor man hours and travel expenses should be recorded in the daily personnel sheets.

2.2.7 Daily Health and Safety Sign-In Forms and Report

- A. The daily health and safety report should include the levels of protection used by field personnel during field operations. This report should also include any exposure incidents, accidents, and any corrective action performed to prevent future incidents.
- B. The daily sign-in form should be signed by all field personnel participating in the daily health and safety meetings.

2.2.8 Photographs

- A. During field activities, photographs should be taken to document significant events that occur during field operations. The photograph should include the subject's relation to site facilities.
- B. Photographs may be used during site investigations to identify topographic features and to document site facilities.
- C. Information concerning each photograph must be entered into the logbook immediately after the photograph has been taken, including the photograph and roll number, a description of the object being photographed, time, and geographic direction in which the photograph was taken.
- D. Photographs of the sampling location should be taken after each sampling event in relation to site features.
- E. The attached photo documentation sheet should be used to mount photos and record information pertaining to the photo. Photo documentation sheets should be attached (by stapling) to the Daily Field report form or stored in a photo file if logbooks are used. The negatives should be stored in a sealed envelope by day and site. The envelope should be marked with site location data, date, and times. Photo negative envelopes should be stored in a photo file in the project file.

2.2.9 Other Field Documentation

Other field documentation may be generated at the site for purposes of quality assurance. These include audit reports and corrective action notices. These are discussed in the QAPP.

2.3 DOCUMENT CONTROL SYSTEM

2.3.1 Project Files

- A. Project files should be maintained onsite including all current project plans, field documentation, and field communications/correspondence records.
- B. A filing system should be used for maintaining project documents in a complete, organized manner. Should the project result in legal action, the status of these records should be easily attainable.
- C. Each file entry should be designated by an appropriate project and task number.
- D. Sign-out sheets should be used to have access to these files. An authorized access list should be posted near the document files and used to ensure that unauthorized personnel will not be able to check out files without the consent of the site manger or higher authority.

2.3.2 Serialization

- A. Chain of custody forms, custody seals, and other data records may be serialized before being used in the field. Serialization will assist in controlling and tracing documents until they are placed into the project file.
- B. Serialization may be accomplished using an inked stamp or adhesive label used to record the serial number used for this purpose. It is not recommended to hand write a serial number on a document without the use of a stamp or label indicating it as such in order to avoid confusion.

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3

Standard Operating Procedure No. 120

BOREHOLE LOGGING AND MATERIAL CLASSIFICATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 120 describes the guidelines for logging and classifying soil samples and rock cores during drilling and sampling operations as described in the Work Plan, or as otherwise specified, for the purpose of characterizing subsurface geologic conditions at the sampling site.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Geologic logging and/or material classification will be conducted for all subsurface and surface soil sampling and rock coring activities based on the following:
 - 1. Visual observation of recovered samples.
 - 2. Examination of drill cuttings.
 - 3. Driller's observations of drilling rig behavior between sample intervals and during coring.
 - 4. Identification of the location of groundwater.
 - 5. Results of downhole tests (e.g., Standard Penetration Test).
- B. Geologic logging and material classification shall be conducted only by a qualified geologist or a hydrogeologist or by a trained logging technician under the supervision of a geologist or a hydrogeologist.
- C. Subsurface soil sampling and rock coring will be conducted in accordance with the guidelines specified in SOP No. 200.
- D. Borehole materials may contain hazardous constituents, and the logging personnel should use caution when extruding and examining samples to prevent exposure. Air monitoring, use of personal protective equipment,

and other safety practices while logging will be in accordance with the approved Site Health and Safety Plan (SHSP).

- E. Tools and equipment used while logging boreholes shall be decontaminated between boring locations and prior to each sampling event in accordance with the requirements of the QAPP and SOP No. 500.
- F. Field data and observations associated with borehole logging shall be documented during logging and for all drilling and sampling activities in accordance with SOP No. 110, if not otherwise specified herein. All field drilling activities should be recorded in a field logbook; boring log forms (Attachment 1) should be used to allow for added detail and organization of field data.

2.2 LOGGING EQUIPMENT AND SUPPLIES

The geologist/hydrogeologist should maintain a collection of logging equipment and supplies needed for sample handling and logging. The equipment and supplies generally used, but not limited to, are listed below.

- Soil Sampling and Logging Equipment and Supplies:
 - Stainless-steel butcher knife
 - Aluminum foil
 - Paper towels
 - Slim stainless-steel spatulas or icing spreaders
 - Ruler, tape measure (in 0.01-inch increments)
 - Color chart
 - Appropriate sample containers and lids
 - Hand penetrometer
 - Photo ionization detector (PID)
 - Logbook and field document forms (as required)
- Rock Coring and Logging Equipment and Supplies:
 - Tape measure (in 0.01-inch increments)
 - Comparative charts for grain size, sphericity, and percentages of silt, clay, and sand
 - Hand lens
 - Pens (indelible ink)
 - Core box(es)

- Other Supplies:
 - Camera
 - 5-gallon plastic buckets and wire brushes
 - Decontamination fluids and supplies
 - Vinyl surgical gloves
 - Plastic bags
 - Distilled water
 - Personal protective equipment, if necessary

2.3 LOGGING AND DOCUMENTATION

- A. The geologist/hydrogeologist shall record all pertinent drilling information on the boring log forms (Attachment 1). The following technical information shall be recorded, as a minimum:
1. Project name and number.
 2. Location (well or boring number) or other sample station identification, including a rough sketch.
 3. Name of geologist or hydrogeologist overseeing the drilling operation.
 4. Approximate ground elevation based on topographic map information.
 5. Well installation or boring date.
 6. Drilling contractor, type of rig, personnel, and equipment.
 7. Drilling method and fluid used.
 8. Drilling fluid gain or loss.
 9. Depth of fluid losses.
 10. Problems with drilling rig.
 11. Water levels encountered during drilling.
 12. Presence and depth of petroleum product.
 13. Casing type and diameter.
 14. Screen type and diameter.
 15. Rock and/or soil classification and lithology.
 16. Lithologic changes and boundaries.

17. USCS classification.
 18. Number of blows per foot.
 19. PID readings (ppm).
 20. Soil sample information (number, type, depth, recovery).
- B. Additionally, when rock coring is performed, the following information shall be recorded:
1. Top and bottom of cored interval.
 2. Core length.
 3. Coring rate in minutes per foot.
 4. Percentage of sample recovered.
 5. Core breakage due to discontinuities (natural fractures vs. coring-induced breaks).
 6. Total core breakage.
 7. Number of breaks per foot.
 8. Type of core (NX, BX, AQ).
 9. Rock Quality Designation (RQD).
- C. The geologic boring log forms should also include a complete visual lithological description of the soil/rock, description of any tests conducted in the borehole, and/or placement and construction details of wells.

2.4 SOIL SAMPLE CLASSIFICATION AND DESCRIPTIONS

2.4.1 Description of Hierarchy

The required order of terms is as follows:

1. Primary soil type followed by gradation modifier, if appropriate.
2. Secondary and tertiary (if needed) soil type modified by “slightly” or “very,” if appropriate.
3. Color, if appropriate.
4. Texture.
5. Consistency, relative density, or the degree of cementation.
6. Structure.

7. Moisture content.
8. Trace components, sorting, and condition of sample.
9. Contamination, odor, if encountered.

2.4.2 Soil Types

Soil description and classification shall be in accordance with the Unified Soils Classification System (ASTM D2488-84). The order and presentation of the terms is as follows:

1. Major soil component of that portion of the soil which is the predominant grain size constituent. Nouns are used and are unabbreviated and capitalized (i.e., CLAY, SILT, SAND, or GRAVEL); "TOPSOIL" is an adequate single term for the naturally occurring organic soil found at the ground surface.
2. Secondary and tertiary (if needed) component greater than 20 percent of total, if present adjective used (i.e., clayey, silty, sandy, or gravelly).

2.4.3 Color

The color descriptions should be consistent with the Geological Society of America (GSA) Rock Color Chart. Numerical Munsell notation is acceptable, but a written description is preferred. The major color is listed first with any accessory colors thereafter (e.g., clay, yellow brown with occasional light-green mottles). If secondary or tertiary descriptors are used, the color designation follows each descriptor.

2.4.4 Consistency and Relative Density

The relative density of cohesionless soils and the consistency of cohesive soils should be included in visual classifications. Attachment 2 can be used in describing the consistency of cohesive soils, and Attachment 3 can be used in describing the relative density of cohesionless soils.

2.4.5 Miscellaneous Descriptions

- A. *Structure* – Some soils possess structural features (e.g., fissures, slickensides, or lenses) and, if so, are described.
- B. *Moisture Content* – Criteria for describing the moisture content of cohesive soils are described in Attachment 4.

- C. *Accessories or Inclusions* – Elements such as rock fragments, fine roots, or nodules are included in the soil description following all other modifiers for the major components of the soil matrix. Any mineralogical or other significant components are described here.
- D. *Contamination* – If monitoring or visual observations indicate the presence of contamination, it should be noted in detail.
- E. *Descriptors* – To provide consistency in logging soils, a summary of descriptor guidelines is provided in Attachment 5.
- F. *Measurement* – All lengths and measurements are recorded in feet and tenths of feet.

2.5 ROCK CLASSIFICATION

2.5.1 Lithology and Texture

- A. The geologist/hydrogeologist should describe the lithology of the rock and its mineral composition. The geological name, such as granite, basalt, or sandstone, usually describes the rock's origin.
- B. The stratigraphic unit should be identified and assigned the local geological name, if appropriate. Stratigraphic age or period should be identified, if possible.
- C. Modifiers should be included to describe rock texture, including grain size, sorting, packing, cementation, etc. (i.e., interlocking, cemented, or laminated-foliated).

2.5.2 Color

The color descriptions should be consistent with the GSA Rock Color Chart. Numerical Munsell notation is acceptable. The major color is listed first with any accessory colors thereafter (e.g., shale, bluish-gray with occasional light-green laminae). If secondary or tertiary descriptors are used, the color designation follows each descriptor.

2.5.3 Hardness

Terms used to describe hardness are described below. One common method to determine hardness is the Mohs Scale of Hardness defined as follows:

Descriptive Term	Defining Characteristics
Very Hard	Cannot be scratched with knife. Does not leave a groove on the rock surface when scratched.
Hard	Difficult to scratch with knife. Leaves a faint groove with sharp edges.
Medium	Can be scratched with knife. Leaves a well-defined groove with sharp edges.
Soft	Easily scratches with knife. Leaves a deep groove with broken edges.
Very Soft	Can be scratched with fingernail.

2.5.4 Weathering

Terms used to describe weathering are described below:

Descriptive Term	Defining Characteristics
Fresh	Rock is unstained. May be fractured, but discontinuities are not stained.
Slightly	Rock is unstained. Discontinuities show some staining on the surface, but discoloration does not penetrate rock mass.
Moderate	Discontinuous surfaces are stained. Discoloration may extend into rock mass along discontinuous surfaces.
High	Individual rock fragments are thoroughly stained and can be crushed with pressure of a hammer. Discontinuous surfaces are thoroughly stained and may crumble.
Severe	Rock appears to consist of gravel-sized fragments in a "soil" matrix. Individual fragments are thoroughly discolored and can be broken with fingers.

2.5.5 Rock Matrix Descriptions

- A. Grain size is a term that describes the fabric of the rock matrix. It is usually described as fine-grained, medium-grained, or coarse-grained. The modified Wentworth scale should be used.
- B. A description of bedding (after Ingram, 1954) or fracture joint spacing should be provided according to the following:

Spacing	Bedding	Joints/Fractures
<1 inch	Very thin	Very close
1 inch - 4 inches	Thin	Close
4 inches - 1 foot	Medium	Moderately close
1 foot - 4.5 feet	Thick	Wide
>4.5 feet	Very thick	Very wide

- C. Discontinuity descriptions are terms that describe number, depth, and type of natural discontinuities. They also describe density, orientation, staining, planarity, alteration, joint or fracture fillings, and structural features.

2.6 ROCK CORE HANDLING

- A. Core samples must be placed into core boxes in the sequence of recovery, with the top of the core placed in the upper left corner of the box. At the bottom of each core run, spacer blocks must be placed to separate the runs. The spacer should be indelibly labeled with the drilling depth to the bottom of the core run; regardless of how much core was actually recovered from the run. Figure 120-1 shows the proper storage and labeling methods.
- B. Spacer blocks should be placed in the core box and labeled appropriately to indicate zones of core loss, if known. Where core samples are removed for laboratory testing, blocks equal in length to the core removed are placed in the box. If wooden core boxes are used, spacer blocks should be nailed securely in place.
- C. The core boxes for each boring should be consecutively numbered from the top of the boring to the bottom. Core from only one boring should be placed in a core box.
- D. The core boxes containing recovered rock cores should be photographed.
- E. One core box should be photographed at a time. The box lid is framed in the picture to include information printed on the inside of the lid. Be sure to include a legible scale in the picture. Photographs are taken in the field most easily and efficiently with natural light and while the core is fresh.
- F. When transporting a boxed core, the box should be moved only if the lid is closed and secured with tape or nails.

FIGURES

OUTSIDE LID

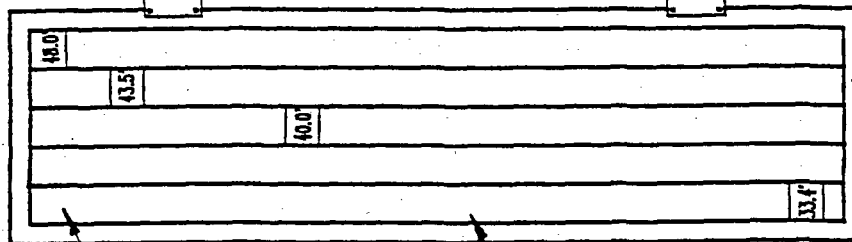
GB18
P2529.02
28.4'-52.9'
BOX 2 OF 2
4/15/94

INSIDE LID

TOP	RUN NO.	DEPTH	RECOVERY		RQD	GB18 P2529.02 BOX 2 OF 2 4/15/94
	R-1	28.4'-38.4' (10.0')	4.0	40%	83%	
	R-2	38.4'-48.4' (10.0')	5.5	55%	42%	
	R-3	48.4'-52.9' (4.5')	4.0	40%	40%	

LEFT END

P2529.02 GB18
28.4'-52.9' 2 OF 2



TOP OF CORE

INSIDE BOX

PROPER ROCK CORE STORAGE
AND LABELING METHODS

CHECK BY DJL
DRAWN BY RGW
DATE 2-7-94
SCALE NONE
CAD NO. 2529101S
PRJ NO. 2529.01-01
FIGURE

120-1

ATTACHMENT 1

BORING LOG FORM

[illegible]

ATTACHMENT 2

FIELD CLASSIFICATION OF SOILS

CONSISTENCY OF COHESIVE SOILS

Consistency	Rule-of-Thumb	Blows * per Foot
Very Soft	Core (height = twice diameter) sags under own weight	0 - 1
Soft	Can be easily pinched in two between thumb and forefinger	2 - 4
Firm (medium stiff)	Can be imprinted easily with fingers	5 - 8
Stiff	Can be imprinted with considerable pressure from fingers	9 - 15
Very Stiff	Barely can be imprinted by pressure from fingers	16 - 30
Hard	Can not be imprinted by fingers	>30

- * Blows as measured with 2-inch OD, 1³/₈-inch ID sampler driven 1 foot by 140-pound hammer falling 30 inches. See Standard Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM D 1586-84. The resistances measured with a 2-inch ID, 2¹/₂-inch OD sampler driven with a 300-pound hammer falling 18 inches, as specified by some building codes, are roughly equivalent to those measured by the standard test. The consistency shown is not applicable if the blow counts are increased by the presence of rock fragments, chert, pebbles, etc.

ATTACHMENT 3

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY OF COHESIONLESS SOILS

Term	Rule-of-Thumb	Blows per Foot *
Very Loose	Easily penetrated with a ½-inch diameter steel rod pushed by hand	0 - 4
Loose	Easily penetrated with a ½-inch diameter steel rod pushed by hand	5 - 10
Medium Dense	Easily penetrated with a ½-inch diameter rod driven with a 5-pound hammer	11 - 30
Dense	Penetrated a foot with ½-inch diameter steel rod driven with a 5-pound hammer	31 - 50
Very Dense	Penetrated only a few inches with ½-inch steel rod driven with a 5-pound hammer	>50

- * Blows as measured with 2-inch OD, 1³/₈-inch ID sampler driven 1 foot by 140-pound hammer falling 30 inches. See Standard Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM D 1586-84. The resistances measured with a 2-inch ID, 2½-inch OD sampler driven with a 300-pound hammer falling 18 inches, as specified by some building codes, are roughly equivalent to those measured by the standard test. The consistency shown is not applicable if the blow counts are increased by the presence of rock fragments, chert, pebbles, etc.

ATTACHMENT 4

CRITERIA FOR ESTIMATING MOISTURE CONTENT OF SOILS

CRITERIA FOR ESTIMATING MOISTURE CONTENT OF SOILS

Term	Relative Moisture	
	Cohesive Soil	Cohesionless Soil
Dry	Powdery	Not moist to the touch
Damp	Moisture content below plastic limit	Feels moist to touch, but cannot be molded
Moist	Moisture content above plastic limit, but below liquid limit	Feels moist to touch and can be molded
Wet	Moisture content above liquid limit	Free water drips from the sample

ATTACHMENT 5

STANDARD SOIL DESCRIPTORS

STANDARD SOIL DESCRIPTORS

Grain Size Terminology		
Boulders		12-inch diameter or more
Cobbles		3- to 12-inch diameter
Gravel	Coarse	0.75 inch to 3 inches
	Fine	0.19 inch to 0.75 inch
Sand	Very Coarse	1 mm to 2 mm
	Coarse	0.5 mm to 1 mm
	Medium	0.25 mm to 0.5 mm
	Fine	0.06 mm to 0.25 mm
Silt		0.004 mm to 0.06 mm
Clay		0.004 mm or less

Consistency	
Very Soft	<2 blows/foot
Soft	2 to 4 blows/foot
Medium Stiff	5 to 8 blows/foot
Stiff	9 to 14 blows/foot
Very Stiff	15 to 30 blows/foot
Hard	>30 blows/foot

Density	
Very Loose	<2 blows/foot
Loose	2 to 10 blows/foot
Medium Dense	11 to 30 blows/foot
Dense	31 to 50 blows/foot
Very Dense	>50 blows/foot

STANDARD SOIL DESCRIPTORS

Estimated Plasticity, Silt/Clay Content		
Thread Diameter (inches)	PI	Identification
1/4	0	Silt
1/8	5 - 10	Clayey Silt
1/16	10 - 20	Clay and Silt
1/32	20 - 40	Silty Clay
1/64	40	Clay

Relative Proportions of Component	
Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Order and Punctuation	
1	Primary Soil Type
2	Secondary Soil Type
3	Tertiary Soil Type
4	Color
5	Consistency, Density (following each Soil Type)
6	Structure
7	Moisture Content
8	Trace Components, Sorting

Standard Operating Procedure No. 200

SOIL SAMPLING AND ROCK CORING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 200 describes the guidelines for obtaining surface and subsurface soil and rock samples as stated in the Work Plan or as otherwise specified. Soil sampling and rock coring is conducted to evaluate surface and subsurface conditions.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Boreholes or test pits are drilled or excavated to provide stratigraphic, hydrogeologic, and geotechnical information on subsurface conditions, and to obtain representative disturbed or undisturbed samples for identification and laboratory testing. Boreholes are drilled to provide holes for geophysical logging, downhole hydraulic testing, and to install groundwater monitoring wells or other types of wells.
- B. Prior to drilling or excavating test pits, the following steps must be taken:
 - 1. Obtain permits from the appropriate state agency or agencies, if required. If there is a fee for permits, subcontractors usually include this as part of their fee.
 - 2. Notify (verbally or in writing) the appropriate state (and sometimes federal) authorities in advance of the date that drilling or excavating is scheduled to begin.
 - 3. Check for buried and overhead utilities at all planned drilling/excavating locations. For reasons of safety and liability, no hole should be advanced if this step has not been completed.
- C. Conduct sampling in accordance with the Site Health and Safety Plan (SHSP), adhering to all of its provisions for protection of the field crew.
- D. Dispose of all cuttings and discharge water in accordance with regulations. Permits may be required.

- E. A qualified field geologist or hydrogeologist must be present (onsite) during drilling or excavating.

2.2 SOIL SAMPLING EQUIPMENT AND METHODS

2.2.1 Manual Sampling Methods

- A. In general, hand sampling using manually operated equipment is a quick and inexpensive sampling technique for shallow depths when precise data or high quality control is generally not required. The most common hand-operated samplers are hand augers, plugs, tubes, split-barrel or fixed piston samplers that are pushed or driven by hand. Hand augers are easily used at depths less than 10 feet. Pushed samplers can be used to obtain samples within about 3 feet of the surface or, with appropriate extensions, ahead of an augured hole.
- B. The most commonly used manually operated hand augers include the ship, closed-spiral, and open-spiral augers. In operation, a hand auger is attached to the bottom of a length of pipe that has a crossarm at the top. The hole is drilled by turning this crossarm at the same time the operator presses the auger into the ground. As the auger is advanced and becomes filled with soil, it is taken from the hole, and the soil is removed. Additional lengths of pipe are added as required.
- C. Care must be taken to prevent (to the extent possible) mixing of the soil from upper portions of the hole with lower samples. This is most likely to be a problem when augers are used to advance a hole and obtain samples from soil cuttings.
- D. Because of the unpredictable disposal methods that have been used at many uncontrolled waste sites, sampling devices must never be forced into an abruptly hard material. The stiffness may be a natural lithology change, a rock ledge or cobble, or a buried drum. If resistance is encountered while auguring or pushing a sampler, the procedure must be stopped. The depth at which resistance was met should be entered into the field logbook or the appropriate field activity form.

2.2.2 Split-Spoon Sampler

- A. The split-spoon type sampler is a thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end of the barrel; the upper end contains a check valve and is connected to the drilling rods. When a boring is advanced to the point that a sample is to be

taken, drill tools are removed, and the sampler is lowered into the hole attached to the bottom of the drill rods.

- B. The sampler should be driven 18 inches into the ground or until refusal occurs in accordance with a standard penetration test (ASTM D 1586) that provides a measure of strength and density. The effort taken to drive the sampler the last 12 inches is recorded at 6-inch intervals, and the sampler is removed from the boring. The density of the sampled material is obtained by counting the blows per foot as the split-spoon sampler is driven by a 140-lb hammer falling 30 inches. Only disturbed samples are obtained using this procedure.
- C. The standard size split-spoon sampler is 2-inch outside diameter (OD), 1³/₈-inch inside diameter (ID), and 24 inches long. When soil samples are taken for chemical analysis, a 2- or 2½-inch ID sampler should be used to provide a larger volume of material, but cannot be used to calculate strength or density properties by using the stated ASTM test method.
- D. Upon retrieval, rinse or wipe excess soil or drilling fluid from the sampler's exterior, remove the cutting shoe, and break open the two halves of the sampler. Describe the sample in accordance with SOP No. 120. Collect samples for geotechnical and/or chemical analysis and decontaminate the sampler tube. The split-spoon sampler should be decontaminated between sample intervals in accordance with SOP No. 500.
- E. Liner tubes or sleeves may be incorporated in certain samplers to contain samples temporarily. The liner tubes may be constructed from brass, plastic, or other inert materials used to store and transport the samples. If a sample is to be stored in the liner tube, the tube ends should first be covered with Teflon film, followed by a plastic slip cap. On each sample end, the Teflon film should be trimmed, and the cap sealed with vinyl tape to the liner tube. The sample liner should be labeled with depth, date, sample number, project number, top and bottom, and boring/well number. If the sampler is not to be stored in the liner, it can be transferred from the sampler to the appropriate sample container using either the liner tube or a stainless steel or plastic spoon or spatula.
- F. When taking samples for geotechnical analyses, the disturbed soil samples removed from the sampler are placed in a sealable glass jar and labeled to indicate the project name and number, boring number,

sample number, and depths at top and bottom of the sample interval. This information is marked on the jar lid using a permanent marker. Other information required by the field engineer or geologist should be recorded in the field logbook.

2.2.3 Continuous Core Barrel Sampler (CME-Type)

- A. A continuous core barrel sampler (CME-Type) is 5 feet long and fits inside the lead auger of the hollow-stem auger column. The sampler retrieves a 5-foot section of partially disturbed soil samples.
- B. The sampler assembly consists of either a split barrel or solid barrel that can be used with or without liners. The split-barrel sampler is most commonly used because it is easier to access and remove the core samples.
- C. The sampler is attached to the drill rod and is locked in-place inside the auger column. The open end of the sampler extends a short distance ahead of the cutting head of the lead auger.
- D. The hollow-stem auger column is advanced 5 feet while the soil enters the non-rotating core sampling barrel. The barrel is then retrieved with the drill rod, and the core is extruded from the sampler.
- E. The core barrel sampler takes the place of the pilot bit, thereby reducing sampling time. The sampler is most efficient in clays, silts, and fine sand.

2.2.4 Direct-Push Sampler (Geoprobe™)

- A. A direct-push sampler is a 2 or 4-feet long, hollow steel barrel that houses an acetate liner. One end of the barrel is closed and attached to length steel rods. The remaining end of the barrel remains open to accept soil.
- B. The open end of the sampler is hydraulically driven into the ground, while the soil enters the barrel and liner. The barrel is then retrieved and the liner, containing the soil, is removed.

2.2.5 Thin-Walled (Shelby) Tube Samplers

- A. Thin-walled samplers, such as a Shelby tube, should be used to collect relatively undisturbed samples of soil from borings. The samplers are constructed of steel tubing about 1 to 3 mm thick, depending upon its

diameter. The lower end has a tapered cutting edge. The upper end is fastened to a sample head adapter with a check valve to help hold the sample in the tube when the tube is being withdrawn from the ground. Thin-walled tube samples are obtained by any one of several methods including pushed-tube, Pitcher sampler, Denison sampler, and piston sampler methods.

- B. In obtaining pushed-tube samples, the tube is advanced by hydraulically pushing it in one continuous movement with the drill rig. At the end of the designated push interval and before lifting the sample, the tube is twisted to break the bottom of the sample.
- C. One of two methods may be employed for handling the sample once it is retrieved from the boring:
 - 1. Extruding the sample from the sample tube in the field using an extruding device on the drilling rig, subsequently handling and containerizing specimen at the drilling site.
 - 2. Leaving the sample in the sampling tube, preparing it for transportation, with subsequent extrusion and handling elsewhere. In this case, the Shelby tube should be labeled with date, depth, sample number, project number, boring/well number, and top and bottom.
- D. A hydraulic extruder should be used in all cases to minimize disturbance. To extrude the sample from the tube, connect the tube to the extruding device in the appropriate fashion for that type extruder. Some extruding devices push the sample in the same direction that the sample entered the tube, pushing out the top, while others push it out the bottom. It does not matter for environmental sampling, but the orientation of the sample should be known and kept clear by the sampling personnel.
- E. Catch the sample on a split section of PVC pipe lined with polyethylene sheeting or aluminum foil. Do not use waxed paper. Carefully pour off drilling fluids and rake away cuttings or slough material at the top end of the sample, leaving only the true sample interval. Transfer the sample to a cutting board by lifting with the poly/sheeting or aluminum foil. Measure the length of the sample.
- F. Log and describe sampled material in accordance with the geological logging and classification procedures specified in SOP No. 120.

- G. Samples for geotechnical testing should be handled and packaged in accordance with standard practices for geotechnical investigations. However, samples should be identified as potentially containing hazardous or toxic chemicals.
- H. Shelby tubes should not be reused for subsequent sampling intervals. Be sure to bring a sufficient number of decontaminated sampling tubes to the sampling location and protect them from being contaminated before use.

2.2.6 Rotasonic Sampling

- A. Rotasonic sampling utilizes a 10-foot long core barrel to retrieve a solid length of soil. The sampler consists of a hollow barrel that is used without liners.
- B. The core barrel is attached to the drill rods and vibrated into the ground. A larger diameter secondary casing is driven around the outside of the core barrel. The core barrel is then retrieved with the sample.
- C. The soil sample is gravity fed (assisted by vibrating the core barrel) into plastic sample bags with a diameter similar to the core barrel.
- D. If the sample is locked in the core barrel (cohesive silts and clays), sample removal is assisted by introducing water pressure into the top of the core barrel.

2.2.7 Cuttings or Wash Samples

- A. Drill cuttings or wash samples may be taken as the boring is advanced. A stainless steel or plastic scoop can be used to obtain a sample from the cuttings pile. The shovel used by drilling personnel to move cuttings should be stainless steel.
- B. Prepare boring logs and describe the cuttings or wash samples according to the geological logging and classification procedures specified in SOP No. 120.

2.2.8 Test Pit Excavation and Sampling

- A. Test pits, including trenches, consist of open shallow excavations to determine the subsurface conditions for engineering and geological purposes. Test pits at hazardous waste sites are typically conducted for waste characterization and waste source identification.

- B. Test pits are excavated manually or by machine including backhoes, bulldozers, and trackhoes.
- C. Test pit excavations must be in accordance with OSHA regulations, 29 CFR 1926, 29 CFR 1910.120, and 29 CFR 1910.134. All excavations deeper than 4 feet must be stabilized before personnel can enter the test pit or trench. Test pit or trenches deeper than 4 feet are considered confined spaces. Confined space entry forms should be completed and approved by the Site Health and Safety Officer. Continuous air monitoring of the work area is required.
- D. Test pits are typically less than 15 feet below the ground surface. If data is required to characterize the soil at depths greater than 15 feet, the data should be obtained from soil borings.
- E. Test pit locations should be documented in reference to at least two permanent landmarks on a scaled map. The dimensions and a rough sketch of the test pit should be recorded in the field activity log and field logbook.
- F. Photographs of specific geologic features or contamination zones should be taken for documentation purposes. A scale should be placed near the test pit and incorporated in the photograph. The photograph, film roll number, direction, description, date of activity, and location of the trench activity should be recorded in the field logbook.
- G. Soil samples can be collected from the backhoe/trackhoe bucket or directly from the wall or base of the test pit, depending on the depth of the pit. Disturbed samples are collected using a stainless steel scoop, shovel, or trowel. Undisturbed samples are typically collected using a hand auger and/or other coring tool. Soil sampling must be in accordance with all applicable health and safety regulations.

2.2.9 Surface Soil Sampling

Surface soil samples are collected to determine the surface soil conditions and characterize the waste source. Surface soil samples are generally collected at depths of less than 1 to 3 feet below the ground surface.

- A. Before sample collection, remove all surface materials (i.e., excess gravel, vegetation, etc.) from the sample location.
- B. Soil samples may be collected using a stainless steel scoop, trowel, or hand auger.

- C. The sample location should be marked with a wooden stake and measured in reference to two permanent landmarks. The sample appearance, depth, and location should be recorded in the field logbook and/or appropriate field activity form.
- D. Sampling should be conducted in accordance with the SHSP.

2.3 ROCK CORING EQUIPMENT AND METHODS

- A. Rock coring will be initiated at the completion of surficial material sampling after properly seating the drilling stem into/onto the upper bedrock surface.
- B. NX core barrel samplers may be used to collect core samples of consolidated and semi-consolidated rock. A 5-foot-long core sample can be obtained with this sampler.
- C. A minimum of two 5-foot core samples or one 10-foot core sample can be obtained through dual-wall string using AQ coring equipment. AQ coring equipment has an outside diameter of 1.89 inches and yields a core with an outside diameter of 1.06 inches.
- D. 10-foot core samples can be obtained through Rotasonic coring equipment. Rotasonic coring equipment has an outside diameter of 5 inches and yields a core with an outside diameter of 4.25 inches.
- E. The supervising geologist will log the specific depth of each coring interval and will determine rock type, rock quality, and any notable structural features (open fissures, zones of weathering, zones of mineralization, lamination/layering, discontinuities, etc.).
- F. All rock cores will be placed in the core boxes, photographed, and stored in a secured area in accordance with SOP No. 120.

2.4 SAMPLING AND SPECIMEN PREPARATION

- A. Select representative sections of the specimen for chemical and/or geotechnical analysis. Based on analytical requirement and contract laboratory specifications, chemical analysis samples should be placed in appropriate sample containers. Samples for analytical procedures requiring zero headspace should be collected first. For geotechnical analysis of cohesive samples, cut minimally disturbed sections of the specimen and place it in the appropriate sample container.

- B. Selected samples should represent the entire specimen or sampling interval.
- C. Samples should be preserved and holding times should be observed according to analytical requirements and laboratory specifications, or as outlined in SOP No. 910.
- D. If replicate or split samples are required, adjust the sections so that the additional samples are essentially identical.
- E. Samples collected during rock coring samples should be logged and stored according to the procedures outlined in SOP No. 120.
- F. Samples should be prepared for shipment in accordance with the specified procedures as described in SOP Nos. 911 and 912.

3.0 SUPPORTING MATERIALS

In addition to materials provided by a subcontractor, the geologist/engineer should have the following:

- Sample bottles/containers and labels
- Sample cutting/extracting equipment (scoops, trowels, shovels, hand augers)
- Boring logs and/or material sampling forms
- Field logbook
- Chain of custody forms
- Depth and length measurement devices
- Stakes and fluorescent flagging tape
- Decontamination materials
- Coolers and ice packs
- Personal protective equipment
- Camera
- Core boxes

4.0 DOCUMENTATION

- A. Record sample information, labeling, and custody control in accordance with requirements specified in SOP Nos. 910 and 912.
- B. Specific procedures for describing the samples and logging subsurface soil samples are presented in SOP No. 120. The material sampling form (Attachment 1) should be used to document soil sampling activities other than drilling. Briefly describe all soil sampling activities in the field logbook as specified in SOP No. 110.

ATTACHMENT 1

MATERIAL SAMPLING FORM

Standard Operating Procedure No. 210

WELL INSTALLATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 210 describes the guidelines for the installation of monitoring wells, recovery wells, and observation wells as described in the Work Plan, or as otherwise specified. Monitoring wells and observation wells are installed to determine depth to groundwater and monitor fluctuations in groundwater elevation, to determine and monitor the depth and thickness of free phase petroleum products (if present), and obtain groundwater and/or free phase petroleum products samples for laboratory analysis. Recovery wells are installed to conduct groundwater pumping tests, free phase petroleum product recovery tests, and aquifer injection tests.

2.0 EXECUTION

2.1 DESIGN REQUIREMENTS

2.1.1 General Requirements

- A. Well construction procedures should meet regulatory agency requirements. In addition, licensing and/or certification of the driller may be required.
- B. A qualified geologist/hydrogeologist should be present during well installation to document the subsurface stratigraphy and construction details for each well.
- C. The well designs should meet two basic criteria: (1) groundwater and/or other fluids (i.e., product) must move freely into the well, and (2) vertical migration of surface water or undesired groundwater to the well intake zone must, to the extent possible, be eliminated.
- D. Factors that influence the location of wells should be considered and include the following:
 - 1. Objectives of the Work Plan.
 - 2. Location of facilities to be monitored.

3. Groundwater gradient.
4. Location of aboveground and underground utilities and manmade features.
5. Accessibility to desired areas.

2.1.2 Well Installation Materials Selection

- A. Materials used in the construction of wells must remain essentially chemically inert with respect to free-phase petroleum products and dissolved contaminants in the groundwater for the duration of the remedial action.
- B. The most commonly used well construction materials are PVC and stainless steel. PVC is the least expensive and easiest material to use. It is generally believed that PVC does not decompose in contact with groundwater containing low concentrations of organics.
- C. Stainless steel is chemically inert, provides greater structural strength, and its use may be advantageous for large-diameter wells. Teflon casing is chemically inert but is very expensive.
- D. Well casing and screen are available in threaded or unthreaded sections and typically in lengths of 5, 10, and 20 feet. Threaded pipe joints may be wrapped with Teflon tape to facilitate joining and to improve the seal. Sections of casing and screen should be assembled onsite to allow inspection immediately before installation. No solvents or adhesive compounds should be used on the threaded PVC or Teflon pipe.
- E. Well materials should be cleaned before well installation. Two methods are acceptable: high-pressure hot water or steam, and detergent wash and distilled rinse. The former is preferred because it is easier and faster. Decontamination procedures are presented in SOP No. 500.

2.1.3 Well Types and Construction Specifications

Well types consist of monitoring and observation wells, recovery wells, and injection wells.

Monitoring and Observation Wells

1. The design of the wells consists of a section of slotted well casing or well screen connected to a riser pipe that extends above the ground

surface. Typically, a filter pack is placed in the annular space between the screen and the borehole wall. A 2-foot seal composed of hydrated bentonite pellets/chips is placed on top of the filter pack. The remaining height of annulus is sealed and/or grouted to the surface with a cement, bentonite/cement, or high solid bentonite grout. A lockable protective casing is constructed over the stick-up portion of the wells.

2. The diameter of the borehole and the inside diameter of any drill casing or hollow stem auger should be at least 3 inches greater than the outside diameter of the well casing and screen. This annular clearance facilitates the placement of the filter pack and grout around the outside of the well screen and casing.
3. The monitoring well screens are installed either across or beneath the upper surface of the water table and are typically 10-feet long.

2.2 BOREHOLE ADVANCEMENT

2.2.1 General

- A. Boreholes used to install wells should be drilled with the following objectives:
 1. To provide geological data on subsurface conditions, namely stratigraphy, occurrence of groundwater, and depth to bedrock.
 2. To obtain representative disturbed or undisturbed samples for identification and laboratory testing.
 3. To install wells.
- B. Prior to drilling, the following steps must be taken:
 1. Obtain permits from the appropriate state agency or agencies. There is a fee for permits, and drilling subcontractors usually include this as part of their fee.
 2. Notify (verbally or in writing) the appropriate state (and federal, if required) authorities in advance of the date that drilling is scheduled to begin.

3. Check for buried utility lines at all planned drilling locations. For reasons of safety and liability, no drill hole should be advanced if this step has not been completed.
4. Prepare and implement an approved Site Health and Safety Plan, adhering to all of its provisions for protection of the field crew.
5. Make provisions for disposal of all cuttings and discharge water in accordance with regulations. Permits may be required.
6. A qualified field geologist/hydrogeologist should be present onsite during drilling.

2.2.2 Selection of Drilling Method

- A. Drilling methods should generally be limited to augering or rotary methods using water- or air-based drilling fluids.
- B. Drilling methods should be selected based on the following general factors:
 1. The expected nature of the subsurface materials to be encountered in the boring.
 2. Site accessibility, considering the size, clearance, and mobility of the drilling equipment.
 3. Availability of drilling water and the acceptability of drilling fluids in the well.
 4. Diameter and depth of the well desired, including consideration of the need to set casing to prevent commingling of different transmissive zones.
 5. The nature and effects of contaminations expected during the drilling.
- C. It should be recognized that many factors must be considered when deciding which drilling methods are most appropriate at a site under specific conditions. The factors related to hazardous waste investigation concerns for the drilling methods are summarized in Table 210-1. Advantages and disadvantages of each technique are identified therein.

2.3 MONITORING WELL INSTALLATION

2.3.1 Well Components

- A. Typical well components in general order of placement are as follows:
1. Surface casing (if used)
 2. Well casing
 3. Screen(s)
 4. Filter pack (gravel or sand pack)
 5. Bentonite seal
 6. Annular seal (grout)
 7. Well head protector casing
 8. Well head apron and guard posts
- B. Surface casing, if needed, should be installed during borehole advancement for sealing the ground surface and subsurface transmissive zones not desired to be intercepted by the well from the borehole. Surface casing may also be needed to provide lateral support for loose unconsolidated formations that may slough into or collapse around the borehole during drilling or well installation. Casing may be extended in a telescopic fashion to permit casing through intermittent transmissive zones at greater depths to limit casing size and cost requirements.
- C. Screens are perforated or slotted sections of casing typically of the same size and material as the well casing. The purpose of the well screen is to allow water and/or other fluids (i.e., product) to enter the well easily while preventing entry of large amounts of sediment. The slot size of the well screen is usually determined based on selection of the filter pack material. Both are commonly related to the grain size analysis of the formation material. Methods of determining appropriate screen slot size are listed in the EPA Manual of Water Well Construction Practices. Typically, 10-slot (0.010 inch slot width) or 20-slot (0.020 inch slot width) screens are used. The length of the screen depends on the sampling objective, water level fluctuations, product thickness, and thickness of the transmissive zone of the formation.
- D. The well casing is the primary conduit to the desired borehole interval to be monitored. It serves to seal off other stratigraphic zones from the groundwater inside the well and provides unobstructed access to the

well screens. The well casing extends from the top of the well screen to either above or flush with the ground surface. It is typically a single-walled pipe, flush-threaded, of the smallest diameter to facilitate sampling equipment and to support its own weight during installation.

- E. A filter pack consisting of clean silica sand or pea gravel is placed in the annular space extending to at least 2 feet above the top of the screen. The filter pack will stabilize the aquifer formation, minimize the entry of fine-grained material into the screen, permit use of screens with different sizes of slot, and will increase the effective well diameter and water collection zone.
- F. A bentonite seal consisting of pellets or chips should be installed above the filter pack to seal more effectively the well's water collection zone and to prevent the intrusion of overlying grout material into the filter pack. The bentonite pellets or chips should be slowly poured from the top of the borehole to prevent bridging. At least 2 feet of bentonite seal should be placed on top of the filter pack. If the bentonite seal is above the saturated zone, the bentonite pellets or chips should be hydrated with distilled water before grouting the remaining annular space. The hydrated pellets or chips should be allowed to set for a minimum of 15 minutes. Bentonite chips are preferred over pellets or balls when the seal is below the water table because the chips hydrate less rapidly and bridging is less common.
- G. The annular space above the bentonite seal should be grouted with a cement, high-solids bentonite, or bentonite/cement grout to within 5 feet below the ground surface. The primary purpose of grouting is to minimize the vertical migration of water to the groundwater intake zone and to increase the integrity of the well casing. Grout design and installation is presented in SOP No. 211.
- H. A 2-foot concrete plug should be installed above the annular grout. The concrete plug is used to set the protective well cover and to prevent frost heave of the concrete pad or apron. The concrete apron should be at least 3.5 inches thick, and it should be sloped to allow water drainage away from the well.
- I. A protective cover with a locking cap should be installed after the well has been set. This cover will protect the exposed well casing from damage and will provide security against tampering with the well. The protective cover typically consists of a steel pipe or box around the well casing. The protective cover is set at least 2 feet into the concrete plug

and wellhead apron. Weep holes (approximately 1/4-inch diameter) are drilled into the base of the protective cover above the concrete apron to allow drainage.

- J. Well-head aprons and guard posts, when used, provide additional surface protection to the well and are generally used for wells in high traffic areas or where a more permanent structure is desired.

2.3.2 Installation Procedures

- A. Upon completion of the boring and subsurface sampling, it should be decided if a well will be installed. If the borehole diameter is not sufficient to install a well, either the borehole should be reamed using a larger diameter auger or a new borehole should be drilled. The new borehole should be at least 5 feet away from the initial boring. The initial soil boring will be grouted according to the procedures outlined in SOP No. 211.
- B. If a well is not installed, the boring should be grouted in accordance with SOP No. 211.
- C. Over-drilling should generally not be conducted to provide room for a well sump or additional filter pack material at the bottom of the borehole beneath the well casing. However, for wash rotary boreholes drilled in soft or highly plastic sediments, loose cuttings may fall to the borehole bottom after backwashing. In this case, it may be necessary to install a 2-foot layer of sand or gravel at the bottom of the boring to provide a firm base on which to set the well assembly to limit settling of the well casing and screen under its own weight.
- D. For mud rotary boreholes, excess drilling fluids should be flushed from the borehole before installing the filter pack and grout seal. This can be accomplished by one or both of the following means:
 - 1. Flush the well using the drilling equipment by pumping clean water down the drill pipe without circulating the returned fluid. This should be accomplished at low pump pressure and with care to avoid scouring or fracturing of the formations.
 - 2. Insert casing and screens with a backwash valve on the bottom end, and then flush the borehole via the well casing at low pressures. The backwash valve not only provides an outlet for flushing, but also provides pressure relief so the screens are not damaged by the backwash fluid pressures.

The latter method should be conducted only if it is determined that the former is not possible, or if the drilling fluid must remain in place in order to install the filter pack.

- E. Connect the screen and well casing while wearing latex gloves. Insert and lower the screen and well casing into the borehole in 10-foot increments. Hand-tighten connections to prevent them from leaking or becoming loose.
- F. The final section of pipe should be measured and field cut, if necessary, before connecting to allow for a stick-up of 2½ feet. The cut end should be rasped and/or sanded smooth, taking care not to let fillings of casing material cling to the inside.
- G. Backwash boring, if necessary, and pour in sand or gravel to seat and support the casing and screen. Based on boring and casing diameters, determine volume of filter pack material required to place the filter approximately 2 feet above the top of the screens. Install filter pack using the following methods, as appropriate.
 - 1. Slowly pour filter material down annulus, being careful to evenly distribute the material around the casing and to avoid the material becoming packed between the sidewall and casing. Use a small-diameter pipe to dislodge packed material and to ensure adequate height and settlement of the filter pack.
 - 2. Pour filter material down tremie pipe placed between boring sidewall and casing. In this method, clean potable or distilled water should be poured in along with the sand or gravel to prevent packing within the tremie. The bottom of the tremie should be kept above the filter material top by at least 5 feet to permit the filter material to evenly fall around the screens. Pack the material with the tremie pipe to ensure adequate height and settlement of the filter pack.
- H. Pour bentonite pellets or chips down the annulus on top of the filter pack. The bentonite should be placed rapidly to prevent swelling and bridging around the casing when it hydrates. The bentonite should be allowed to hydrate for at least 15 minutes before grouting.
- I. The remaining annulus should be sealed by pumping grout via a tremie pipe from the bottom of the annular space of the borehole until the grout returns to the surface displacing all remaining drilling fluid and formation water. The bottom of the tremie pipe should not be placed

within 4 feet of the bentonite seal. Grouting mixture and technique should be in accordance with SOP No. 211. Grout will typically settle 1 to 2 feet. Remove excess grout to allow 2 feet of annular space for the concrete plug.

- J. After the grout has stiffened sufficiently, install the concrete plug up to the ground surface. Set the protective cover, if possible, such that at least 2 feet of its length is embedded in the concrete below the ground surface. It should also be set such that it is not more than approximately 30 to 36 inches above the level where the sampling personnel must stand. A concrete pad approximately 3 feet in diameter and 3.5 feet thick should be formed around the base of the protective cover. The concrete pad should be sloped away from the protective cover to allow flow away from the well. Weep holes should be drilled through the protective cover nominally 1 inch above the top of the concrete apron.
- K. The protective casing should be marked with identifying decals. A locking device should be installed to prevent unauthorized entry or vandalism of the well.
- L. The top of the well casing should be notched with a file to provide a reference point in which to measure water and/or product levels. The elevation of the top of the well casing (reference point) and ground surface at the well should be surveyed relative to a USGS benchmark. The location of the well should also be surveyed in reference to the site coordinate system.
- M. Develop well within 24 to 72 hours following well installation according to the well development procedures outlined in SOP No. 212.

3.0 DOCUMENTATION

- A. Documentation of well installation should be the responsibility of the supervising geologist/hydrogeologist. A well completion report should be prepared after the well is installed. An example of a Well Completion Report is provided in Attachment 1.
- B. The drilling and well installation activities should be recorded in the field logbook or on appropriate forms. The following minimum information should be recorded during and upon completion of every well installation.
 - 1. Project name and number

2. Well location identification
 3. Date of installation and time completed
 4. Drilling methods, crew names, and rig identification
 5. Drilling depths
 6. Generalized subsurface stratigraphy
 7. Total length of casing and screens
 8. Depth to water and/or product
 9. Depth to and length of screened intervals
 10. Depth to top of filter pack
 11. Depth to top of annular seal
 12. Depth to top of bentonite seal
 13. Depth to top of grout
 14. Depth of surface casing (if necessary)
 15. Elevation of top of well casing and ground surface
 16. Name and signature of supervising geologist/hydrogeologist
- C. The licensed driller should also prepare any state-required well completion forms in accordance with the state regulatory requirements. An example form is provided in Attachment 2.

TABLES

TABLE 210-1
Factors Affecting Choice of Drilling Methods

Method	Common Hole Diameter (Inches)	Common Effective Operating Depth (feet)	Considerations Specific to Hazardous Waste Site Investigations
Continuous-Flight Auger	3 - 10	to 150	-- No drilling fluids commonly used that may affect groundwater quality.
			-- Potential for high concentrations of airborne contaminants near drilling personnel from borehole opening and cutting pile
			-- Relatively easy to clean and decontaminate equipment.
			-- User is in close proximity to the hazardous waste.
			-- Disposal of cuttings may be subject to regulation.
			-- Potential for borehole cave-in without casing, especially below water table.
Hollow-Stem Auger	5 - 12	to 100	-- No drilling fluids commonly used that may affect groundwater quality.
			-- Well installation possible inside HSA.
			-- Potential for high concentrations of airborne contaminants from borehole and cuttings.
			-- Below groundwater table, hydrostatic pressure must be maintained inside stem; water could affect groundwater quality.
			-- Difficult to clean and decontaminate inside surfaces of auger flights.
			-- Disposal of cuttings may be subject to regulation.
Water-Based Rotary	3 - 24	Very Deep	-- Water or drilling muds used may affect groundwater quality.
			-- Disposal of cuttings may be subject to regulation.
			-- Difficult to clean and decontaminate inside surfaces of drill stem.
Air-Based Rotary	3 - 24	Very Deep	-- Air flow may dilute contaminants and can be directed away from drilling personnel.
			-- May not require liquid drilling fluid, so groundwater quality would not be affected.
			-- Depending on soil characteristics and hole depth, water or foam may be required in small volumes; groundwater quality may be affected in these cases.
			-- Some air compressors use oil that may contaminate hole.
			-- Difficult to clean and decontaminate inside surfaces of drill stem and bit.

ATTACHMENT 1

WELL COMPLETION REPORT

Well Completion Report

SITE #: _____ COUNTY: _____ WELL #: _____

SITE NAME: _____ BOREHOLE #: _____

STATE _____

PLANE _____

COORDINATE: X _____ Y _____ (or) LATITUDE: _____ LONGITUDE: _____

SURVEYED BY: _____ ILL REGISTRATION #: _____

DRILLING CONTRACTOR: _____ DRILLER: _____

CONSULTING FIRM: _____ GEOLOGIST: _____

DRILLING METHOD: _____ DRILLING FLUIDS (TYPE): _____

LOGGED BY: _____ DATE STARTED: _____ DATE FINISHED: _____

REPORT FORM COMPLETED BY: _____ DATE: _____

ANNULAR SPACE DETAILS

ELEVATIONS DEPTHS (.01 ft)
(MSL) * (BGS)

TYPE OF SURFACE SEAL: _____

TYPE OF ANNULAR SEALANT: _____

INSTALLATION METHOD: _____

SETTING TIME: _____

TYPE OF BENTONITE SEAL-

GRANULAR, PELLET, SLURRY, CHIPS
(CIRCLE ONE)

INSTALLATION METHOD: _____

SETTING TIME: _____

TYPE OF SAND PACK: _____

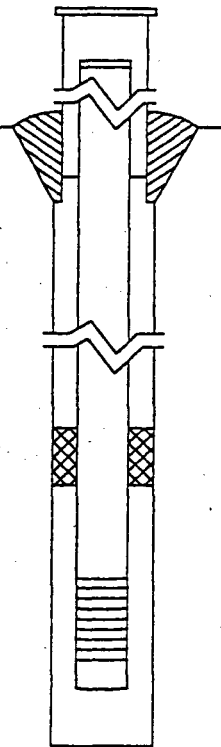
GRAIN SIZE: _____

INSTALLATION METHOD: _____

TYPE OF BACKFILL MATERIAL: _____

(IF APPLICABLE)

INSTALLATION METHOD: _____



TOP OF PROTECTIVE CASING

TOP OF RISER PIPE

GROUND SURFACE

TOP OF ANNULAR SEALANT

STATIC WATER LEVEL
(AFTER COMPLETION)

TOP OF SEAL

TOP OF SANDPACK

TOP OF SCREEN

BOTTOM OF SCREEN

BOTTOM OF WELL

BOTTOM OF BOREHOLE

* REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION

MATERIALS

(CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR OTHER:
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, PVC OR OTHER:
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, PVC OR OTHER:
SCREEN	SS304, SS316, PTFE, PVC OR OTHER:

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in.)	
ID OF RISER PIPE (in)	
PROTECTIVE CASING LENGTH (ft)	
RISER PIPE LENGTH (ft)	
BOTTOM OF SCREEN TO END CAP (ft)	
SCREEN LENGTH (1st SLOT TO LAST SLOT) (ft)	
TOTAL LENGTH OF CASING (ft)	
SCREEN SLOT SIZE **	

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

ATTACHMENT 2

MULTI-PURPOSE COMPLETION REPORT

Please plot well location

Legal Description

_____ 1/4 _____ 1/4 _____ 1/4 of Sec. _____ Twp. _____ Rge. _____

County _____ Well No: _____

Well Owner _____ Phone _____

Address _____

Finding location _____

Lithologic Log			Non-Domestic (OWRB Permitting Required)
Material	From	To	Set- rates

This form shall be filled out by the contractor or his representative for each well constructed under permit. It shall be submitted to the Department of Natural Resources, Bureau of Water Control, upon completion of the work. The information furnished hereon will be used for the purpose of determining the need for additional wells and for the issuance of permits for new wells.

Permit No. _____

New Boring or Well Construction Data

Date: Started _____ Completed _____
Firm _____
Operator _____ Op.No./ _____

Type of Construction ☐ Open Hole ☐ Cased Hole
☐ Temporary ☐ Permanent

Hole Diameter _____ inches total depth _____ feet
Hole Diameter _____ inches total depth _____ feet

CASING RECORD

diameter	from	to
Surface casing _____ inches	_____ feet	_____ feet
Well casing _____ inches	_____ feet	_____ feet
Well casing _____ inches	_____ feet	_____ feet
Well casing _____ inches	_____ feet	_____ feet

SCREEN or PERFORATION RECORD

Type and Slot Size	from	to
_____	_____ feet	_____ feet
_____	_____ feet	_____ feet
_____	_____ feet	_____ feet

FILTER PACK

Type and Size	from	to
_____	_____ feet	_____ feet
_____	_____ feet	_____ feet
_____	_____ feet	_____ feet

SEAL

Cement Grout Surface Seal Installed ☐ Yes ☐ No

Type of Surface Seal _____ from _____ feet to _____ feet
Annular Seal Type _____ feet _____ feet
Type of Filter Pack Seal _____ feet _____ feet

TYPE OF COMPLETION

☐ Above Ground ☐ Pitless Adapter
☐ Flush Mounted

SURFACE PAD (Size in Feet)

_____ X _____ X _____ inches

HYDROLOGIC DATA

First Water Zone Encountered _____ ft.
Approximate Yield _____ GPM Flowing Artesian ☐ Yes ☐ No

Plugging Data

☐ Non-Contaminated ☐ Contaminated

Date Plugged _____
Backfilled From _____ feet _____ feet Type _____
Grouted From _____ feet _____ feet Type _____
Cement Grouted From _____ feet _____ feet Trimmed ☐ Yes ☐ No

Reconditioning Work

Replaced Casing/Screen From _____ feet _____ feet
Deepened Well From _____ feet _____ feet
Redeveloped Well By _____

Certification

The work described above was done under my supervision.
This report is correct to the best of my knowledge.

Name _____ D/P.C. NO. _____
Address _____ Phone _____
Signed _____ Date _____

Pump Installers Completion Report

Static Water Level

Date _____ Static water level _____ feet below land surface

Type of measurement method _____

Pumping Water Level

Method of drawdown ☐ Pump (Size _____ g.p.m.) ☐ Bailer (Size _____ gal)

Drawdown

_____ feet after _____ hours pumping at _____ g.p.m.

_____ feet after _____ hours pumping at _____ g.p.m.

_____ feet after _____ hours pumping at _____ g.p.m.

Wellhead Completion

Type of completion

☐ Pitless adapter ☐ Above ground completion _____ inches above land surface

Is the casing sealed with the required sanitary seal? ☐ Yes ☐ No

Well Location

Distance from the nearest possible source of pollution. Minimum 50 ft well upgradient, 75 ft level, & 100 ft well down gradient.

ft. _____ type or source _____

Elevation of source from well ☐ up-gradient ☐ level ☐ down-gradient

Has this well been disinfected after completion of work? ☐ Yes ☐ No

If this well is a replacement well, has old well been abandoned properly?

☐ Yes ☐ No ☐ Not a replacement well

Pump

Power Type: ☐ Electrical ☐ External _____ HP Rating _____

Pump Type: ☐ Jet ☐ Turbine ☐ Submersible ☐ Windmill ☐ Other _____

Manufacturer's Name _____

Model Number _____ HP _____ RPM _____ Voltage _____

Pump capacity _____ g.p.m.

Length of drop pipe _____ feet Type _____

Depth to bowls or cylinder _____ feet

Pressure Tank

Type: ☐ Plain Steel ☐ Floating Wafer ☐ Diaphragm or Bladder

Brand Name _____

Model No: _____ Capacity _____ Gal

The certification and legal description areas on front side must be completed

Standard Operating Procedure No. 211

GROUTING PROCEDURES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 211 describes the guidelines for grouting boreholes and wells as described in the Work Plan, or as otherwise specified. The purpose of grouting is to seal the boring or annular space of a well to prevent cross-contamination from the surface and/or subsurface formations.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. All borings drilled for the sole purpose of sampling subsurface soil and bedrock shall be grouted from the borehole bottom to the ground surface using a specified grout mixture to seal the formations completely to prevent cross-contamination.
- B. The annular space between the borehole wall and well casing or other subsurface installments shall be pressure-grouted from top of the bentonite seal or filter pack to the ground surface. Specific grout mixture and/or cement-based concrete shall be used to completely seal the formations and prevent cross-contamination.
- C. Movement of contaminants from the borehole to the surface may occur as drilling mud or formation water is displaced during grouting. Therefore, personnel conducting grouting operations shall exercise caution to avoid exposure and follow the prescribed procedures in the approved Site Health and Safety Plan (SHSP) or as outlined in the Work Plan.
- D. Grouting shall be supervised by a qualified geologist/hydrogeologist to ensure that proper materials and techniques are used. The volume of grout and quantity of grout components shall be documented in the field logbook and well completion report.

2.2 GROUT MIXTURE DESIGN

2.2.1 Cement Grout Mixture Design (EPA Standard)

- A. The standard EPA-recommended cement grout mixture consists of a maximum of 6 gallons of potable water per 94-pound bag of Type I Portland cement.
- B. If sand aggregate is used, the recommended mixture is two parts of aggregate by weight to one part cement with no more than 6 gallons of potable water per 94-pound bag of Portland cement. (Based on EPA Manual of Water Well Construction Practices)

2.2.2 Cement/Bentonite Grout Mixture Design

- A. A cement/bentonite grout mixture consists of approximately 6 gallons of potable water for every 8.5 pounds of bentonite gel (6% by weight) and 94 pounds of Portland cement.
- B. Water shall be clean, potable water and free of organics.
- C. Portland cement shall be Type I or Type II and shall be free of hydrated clods and debris.
- D. Bentonite shall be free flowing, high-swelling, and sodium-based bentonite.

2.2.3 High-Solids Bentonite Grout Design

- A. A high-solids bentonite grout mixture shall consist of 14 gallons of potable water for every 50 pounds of powdered bentonite (20% by dry weight).
- B. Water shall be clean, potable water and free of organics.
- C. The grout should be weighed with a mud balance and exhibit a mud density of 10 pounds per gallon (refer to manufacturer's specifications).

2.3 GROUTING PROCEDURES

2.3.1 General

- A. Mix the grout in accordance with the above-recommended portions or by the manufacturer's specifications. Drums or deep tubs are recommended for mixing grout.

- B. Grout should be mixed by slowly adding the dry content to the required volume of water, preferably using a jigger pump or grout pump to circulate the mixture under high pressure and to permit complete blending of grout. Add the required amount of bentonite gradually to the cement mixture and continually mix until adequate viscosity is achieved when preparing cement/bentonite grout. Measure the mud density of the high-solids bentonite grout with the mud balance to ensure a proper mixture.
- C. Where practical, batches should be mixed in volumes sufficient to grout the entire boring or well from the bottom to the ground surface. Continue to agitate mixture during grouting to ensure mixture is uniform and to prevent settling of dry cement.

2.3.2 Recommended Placement Technique

- A. Grout may be placed by a variety of methods including pouring, bailer dumping, tremie pipe, and pumping. Pouring the grout down the annular space is not generally recommended, especially if the depth is greater than approximately 20 feet or if water is standing in the annular space. If the annular space is wide enough to permit the entry of a dumping bailer or tremie pipe, grout may be placed by either of these methods.
- B. The grout should be added near the bottom of the remaining annular space using a tremie pipe. The tremie pipe is slowly raised as the grout rises. Pumping the grout is generally the best method of grouting if the distance to the placement is great or water is standing in the annular space. If grout is pumped through a rotary drill rig pump, care must be taken to adequately clean the pump after grouting is completed.
- C. Use a ¾-inch to 1-inch-diameter PVC pipe for a tremie pipe with a top head connector to a pump hose. Connect pipe lengths necessary to reach bottom of borehole or annular space.
- D. Pump grout via the tremie pipe to the bottom of the boring or remaining annular space and extract the tremie pipe as the grout fills the hole, keeping the end of the tremie 5 to 10 feet below the top of the grout column. Disconnect sections of the tremie pipe as they are extracted.
- E. If the subsurface formations are stable and consolidated, the tremie may be left at the bottom until the grout reaches the surface; however, care should be exercised to keep from fracturing the formation or deeper borings and wells.

- F. Drilling fluids and formation water displaced by the grout should be channeled through a spill collar attached to the surface casing and collected in a mud tub to prevent spillage on the ground. Return fluids, cuttings, and excess grout shall be containerized and handled in accordance with the procedures specified in the Work Plan.
- G. The supervising geologist or hydrogeologist should record the number of sacks of cement and total volume of grout mixed separately for each batch along with the volume of any unused grout remaining after the hole is completely grouted.

3.0 **DOCUMENTATION**

- A. Documenting the grouting operations shall be the responsibility of the geologist or hydrogeologist supervising the drilling operations.
- B. Data supporting proper grouting operations should be recorded in the field logbook or on the appropriate field activity forms and should include, as a minimum, the number of sacks of cement used, the total quantity of grout mixed, and the remaining volume of grout after grouting the borehole or well.

Standard Operating Procedure No. 212

WELL DEVELOPMENT

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 212 describes the guidelines for developing wells as described in the Work Plan or as otherwise specified. Well development is conducted to remove drilling fluids or mudcake from the filter pack, borehole wall, and formation materials to enhance the flow of groundwater and/or product into the well. Well development removes any loose formation materials (i.e., fine sand and silt) from the filter pack that may impact the integrity of groundwater and/or product samples.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS AND CONSIDERATIONS

- A. Well development shall be conducted for all wells for the following reasons:
 - 1. To restore the natural permeability of the formation adjacent to the borehole.
 - 2. To remove clay, silty and other fines from the filter pack and well screen so that water and/or product samples will not be abnormally turbid or contain undue suspended matter.
 - 3. To remove remnant drilling fluids and other contaminants from the well, filter pack, and formation material introduced during drilling.
- B. All equipment, including pumps, hoses, containers, and bailers should be decontaminated before and after introduction into wells to be developed. Decontamination should be followed in accordance with SOP No. 500.
- C. Personnel involved in well development procedures shall follow the prescribed Site Health and Safety Plan (SHSP).

2.2 DEVELOPMENT METHODS

2.2.1 Air Lifting

- A. The airlift method involves pumping compressed air down an eductor pipe placed inside the well casing. Due to its inert characteristic, nitrogen is the preferred gas for air lifting. The use of standard air for well development may impact permeability of the formation surrounding the well screen and groundwater quality.
- B. Pressure applied intermittently and for short periods causes the water to surge up and down inside the casing. Once the desired surging is accomplished, continuously applied air pressure should be used to blow water and suspended sediments upward and out of the well.
- C. Considerable care must be exercised to avoid injecting air directly through the well screen. Air can become trapped in the formation materials outside the well screen and affect subsequent chemical analyses of water samples and hydraulic conductivity measurements. The bottom of the air pipe should not be placed below the top of the screened section of casing.
- D. Another restriction of the use of air is the submergence factor. The submergence factor is defined as the height of the water column above the bottom of the air pipe (in feet) divided by the total length of the air pipe. To result in efficient airlift operation, the submergence factor should be at least 20 percent. This may be difficult to achieve in shallow monitoring wells or wells that contain small volumes of water.

2.2.2 Surge or Plunging

- A. A surge block is a round plunger with pliable edges (constructed of a material such as rubber belting) that will not catch on the well screen. Moving the surge block forcefully up and down inside the well screen causes the water to surge in and out through the screen accomplishing the desired cleaning action. Close monitoring of the amount of pressure generated must be made to prevent cracking of the well casing or screen.
- B. A well slug may also be used to create a surging effect through the filter pack and formation. A slug consists of a PVC rod or pipe (with capped ends) sufficiently weighted to rapidly sink in water. The slug is alternately lowered into and retrieved from the water in the casing to create a water level differential that induces flow into or out of the well

to accomplish the desired cleaning action. This method is less aggressive than using a surge block.

- C. For shallow wells or wells in which the water column in the casing is small, care must be exercised when lowering the slug so as not to drive the slug into the bottom of the casing or against the screens.

2.2.3 Bailing and Pumping

- A. A bailer that is heavy enough to sink rapidly through the water can be raised and lowered through the water column to produce the surging action that is similar to that caused by a surge block or well slug. The bailer, however, has the added capability of removing turbid water and fines each time it is brought to the surface. Bailers are very useful for developing shallow and slow yielding wells. As with surge blocks, it is possible to produce pressure great enough to crack PVC casing. Bailers are the simplest and least costly method of developing a well, but are time-consuming.
- B. Pumping can be used effectively in wells where recharge is rapid. The type and size of the pump used is contingent upon the well design. Pumps also allow removal of turbid water and fines. However, pumps are more difficult to decontaminate than a bailer.

3.0 PROCEDURES

- A. Measure the depth to groundwater in accordance with the guidelines in SOP No. 220 and calculate the standing water volume in the well to be developed. The standing well volume (V) is calculated using the following formula:

$$V = nA (B-C) + CD$$

where,

n = porosity of the filter pack

A = height (in feet) of the saturated filter pack

B = volume (in gallons) of one linear foot of borehole

C = volume (in gallons) of one linear foot of well casing

D = height of the standing water column (in feet) in the well

The height of the standing water column is calculated by subtracting the static water level from the total depth of the well. The volume of water in the well and borehole will vary with diameter.

- B. The data collected during development should be recorded on the well development/groundwater sampling form as outlined in SOP No. 110. An example of this form is provided in Attachment 1.
- C. Water quality parameters will be measured before and during well development. The water quality parameters should include pH, specific conductance, temperature, and turbidity. Visual clarity of the groundwater (including the presence of oil droplets, oil sheen, and hydrocarbon odors) should be noted if observed.
- D. Water quality parameters will be measured after each well volume is removed. The data will be recorded on the field activity form and/or field logbook.
- E. The well will be developed for a minimum of 10 well volumes and until the water quality parameters stabilize. The criteria for parameter stability are summarized below:
 - 1. pH: +/- 0.1 unit
 - 2. Conductivity: +/- 15%
 - 3. Temperature: +/- 0.5 C
 - 4. Turbidity +/- 10%
- F. Development water should be contained in 55-gallon drums and managed in accordance with the FSP.
- G. Appropriate personal protection should be used when encountering product or strong product odors that exceed the action levels specified in the SHSP.

4.0 DOCUMENTATION

Well development activities should be documented in the field logbook, describing the procedures used and any significant occurrences that are observed during development such as apparent recharge rates in the well, condition of the groundwater, and organic vapor readings. Well development data including the depth to static water, standing water volume in the well, total volume of water removed, number of well

volumes removed, and water quality parameters should be recorded on the field activity form (Attachment 1).

ATTACHMENT 1

WELL DEVELOPMENT AND/OR GROUNDWATER SAMPLING FORM

GROUNDWATER DATA FORM

PROJECT INFORMATION																
EVENT		Well Development					Groundwater Sampling					Low-Flow Groundwater Sampling				
Project Name												Well ID				
Project No.												Start Date				
Field Personnel												End Date				
WELL AND DEVELOPMENT / PURGE INFORMATION																
Casing ID						Purging Method						Tube/Pump Intake Depth				
Screened Interval						Pump Make, Size, or Type						Pump Rate				
DEPTH MEASUREMENTS								VOLUME PRODUCTION INFORMATION								
		INITIAL		FINAL		Volume Type:				Borehole				Well Casing		
		Depth	Time	Depth	Time	Linear Feet of Water in Well										
Product						Amount Equal to One Volume										
Groundwater						Total Volumes Produced										
Casing Base																
NOTES:																
PHYSICOCHEMICAL PARAMETERS																
Date	Time (24 hour)	Flow Rate ()	No. of Vol Removed (#)	Volume Purged (gal)	Depth to Water (ft BTOC)	Drawdown (ft)	Temp (° C)	pH	Conduct. (mS/cm)	TDS (ppm)	Dissolv. Oxygen (ppm)	Eh (mV)	PID (ppm)	Turbid. (ntu)	Visual Clarity	

Standard Operating Procedure No. 220

GROUNDWATER AND LNAPL LEVEL MEASUREMENTS

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 220 describes the guidelines for determining groundwater and LNAPL levels in monitoring wells, observation wells, and recovery wells as required in the Work Plan or as otherwise specified. The purpose of measuring groundwater and LNAPL levels will be to determine the depth of groundwater and/or LNAPL, hydraulic gradients, LNAPL thickness, and standing water volume in wells.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Water level and LNAPL (if present) measurements should be obtained at wells designated in the Work Plan. Water and LNAPL levels should be measured in referenced to a common elevation or datum, preferably to a USGS benchmark located at the site. Water and LNAPL depths should be measured from a reference point marked on the top of the casing, which is, in turn, referenced to a permanent benchmark.
- B. Water and product level measurement devices shall be decontaminated as per SOP No. 500 or as specified in the Work Plan before and after measuring at each location.
- C. Personnel obtaining water and product level measurements could be subject to exposure from contamination and should follow the Site Health and Safety Plan (SHSP) regarding this activity. Care shall be exercised to avoid direct skin contact while measuring water level and product depth. All equipment should be decontaminated before and after each measurement.
- D. Water and product level measurements should be recorded in the field logbook and/or the field activity form. The water/product level measurements form is provided in Attachment 1.

3.0 DISCRETE WATER LEVEL MEASUREMENT METHODS AND PROCEDURES

3.1 METHODS

- A. Discrete water level measurements should be made by determining the depth to the water surface from the top of the well casing at the fixed reference point. The fixed reference point is established by permanently marking a point on the northern outer edge (lip) of the well casing. Caution should be exercised so that filings do not fall into the well.
- B. The depth to water can be determined using a steel add-on tape or electronic water level indicator. The steel add-on tape consists of a measuring tape that has 1-foot increments and a 1-foot section at the end of the tape with 0.01-foot increments. The end of the tape is coated with chalk and lowered into the well. The water depth is read from the saturated mark on the chalked tape and added to the depth interval measured at the top of the well casing.

Electronic water level indicators are conducting probes that activate an alarm and a light when they intersect the water. The sounder wire is marked in 0.01-foot intervals to indicate depth. All sounders are equipped with weights to maintain line tension for accurate readings.

- C. Discrete water levels are typically required from a series of wells when data for preparing groundwater contour maps are needed. However, discrete water levels may also be required when monitoring the changes in water level during aquifer testing if aquifer response is sufficiently slow. Continuous water level measurements are discussed in Section 5.0.

3.2 PROCEDURES

3.2.1 Electronic Water Level Indicator

- A. Lower the sounder wire until it just makes contact with the water in the well and the indicator light goes on or the alarm is sounded. Record the position of the wire relative to the reference point at the top of the well casing. Record the actual water level reading to the nearest 0.01-foot. Repeat to confirm depth.
- B. Withdraw the sounder from the well.
- C. Record the water depth in the field logbook and/or the field activity form.

- D. Decontaminate the sounder wire and electrode in accordance with SOP No. 500.

4.0 **DISCRETE LNAPL LEVEL MEASUREMENT METHODS AND PROCEDURES**

4.1 **METHODS**

- A. Discrete LNAPL or product level measurements should be made by determining the depth to the product and water surface from the top of the well casing at the fixed reference point. The fixed reference point is established by permanently marking a point on the northern outer edge (lip) of the well casing. Caution should be exercised so that filings do not fall into the well.
- B. The depth of the product and water level should be obtained using an electronic oil/water interface probe. An oil/water interface probe has a multi-conducting probe that activates different signals, typically pulsating beeps and continuous alarms, when they intersect the product and water, respectively. The sounder wire is marked in 0.01-foot increments to indicate depth. The interface probe is equipped with a weight to maintain line tension and obtain accurate readings.

4.2 **PROCEDURES**

- A. Check the interface probe battery by pressing the test button to ensure the device is operating properly before and after taking the level measurement. Daily battery checks should also be made and documented in the logbook.
- B. Lower the interface probe until it makes contact with the product in the well and the product indicator light goes on or the pulsating alarm is sounded. Record the position of the wire relative to the reference point to the nearest 0.01-foot. Repeat to confirm the depth of the product.
- C. Continue to lower the interface probe, through the product layer, until it makes contact with the water level in the well and the water indicator light goes on or the continuous alarm is sounded. Record the position of the wire to the reference point to the nearest 0.01-foot. Repeat to confirm the depth of the water.
- D. Withdraw the probe from the well.
- E. Record the product and water depth in the field logbook and/or the field activity form.

- F. Decontaminate the sounder wire and probe in accordance with the guidelines in SOP No. 500.

5.0 CONTINUOUS WATER LEVEL MEASUREMENT METHODS AND PROCEDURES

5.1 PRESSURE TRANSDUCER METHOD

Continuous water level measurements are made by determining the height of the water column above a pressure transducer and electronically recording fluctuations in this height with a data logger. The continuous recording of height of water above the transducer is used for aquifer testing where rapid changes in water level are anticipated.

5.2 PROCEDURES

- A. Enter the program into a data logger that has fully charged batteries. Alkaline batteries are preferred. During use, the battery voltage should not drop below the minimum voltage specified by the manufacturer; damage to the data logger and loss of recorded data could result.
- B. Select a pressure transducer for use in a given well that is compatible with both water quality and anticipated pressure sensitivity range (i.e., 5 psi, 30 psi, etc.). The pressure range selected is dictated by the anticipated range in the water column above the transducer and by the desired precision in measurement.
- C. Hook up the transducers to the data logger in the field following manufacturer's instructions. Typically, four to eight input channels are available on the system. Other factors affecting the sampling configuration include cable length; distance between monitored wells; terrain; local human activities (traffic, plant operations); and the ability to secure the system from weather and vandals.
- D. Attach the transducer cable to the data logger and calibrate in air according to manufacturer's instructions. If multiple data loggers are used, internal clock synchronization should also be performed.
- E. Measure water level and depth to the bottom of the well before lowering the transducer into the well. Water levels are measured with an electrical water level indicator; total depth of the well is measured with a device compatible with well depth.

- F. Secure a sanitary fitting (commonly a gasket adapted to the cable diameter) at the surface of the well. Lower transducer into the well through the sanitary fitting to a depth between the water level and the bottom of the well. The transducer must be kept submerged during the period of measurement. Take care to keep the piezometric crystal at the tip of the transducer out of any fine sediment that has accumulated in the bottom of the well. On some transducers, the crystal is protected from sediment intrusion. Measure water level again; record the time indicated on the data logger digital display and water level. From these readings (and other periodic manual water level measurements), the water levels can be converted to elevations.
- G. Transfer data stored in the data logger periodically to a portable computer. The frequency of data transfer depends on available memory and conditions encountered in the field. Data may be transferred as frequently as daily. If the data logger has a wrap-around memory, the information should be transferred so that records are not recorded over.

ATTACHMENT 1

WATER LEVEL MONITORING FORM

WATER LEVEL MONITORING FORM

[illegible]

Standard Operating Procedure No. 310

AIR QUALITY MONITORING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 310 describes the guidelines for performing air quality measurements during various field activities as described in the Work Plan or as otherwise specified. Air quality is monitored during field activities to establish the appropriate action levels and proper personal protection equipment (PPE).

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Guidance provided in this SOP supplements the requirements specified in the Site Health and Safety Plan (SHSP) for the project. The contents herein are intended for use by individuals with proper training and knowledge of the described methods for air quality monitoring.
- B. Air quality measurements should be performed whenever there is a possibility of encountering health-threatening air quality conditions. In most cases, the need to measure air quality will be prompted by suspicion of the presence of hazardous airborne chemicals. In some cases, the need will be prompted by the possibility that oxygen deficient conditions exist.
- C. Field calibration of instruments used for air monitoring shall be in accordance with the manufacturer's specifications or as described in SOP No. 930.
- D. Documentation of air monitoring and calibration activities shall be recorded in the field logbook in accordance with requirements in SOP No. 110.

2.2 DIRECT MEASUREMENT METHODS AND INSTRUMENTS

- A. Real-time air monitoring of the breathing zone using a Direct Measurement Instrument (DMI) will be conducted in the general work area and around the potential source of contaminants such as:

1. The borehole opening during drilling
2. Top of well casing at monitoring wells
3. Pit excavations
4. Surface impoundments
5. Drum and tank openings
6. Valves, vents, and exhausts of plant facilities
7. Stacks and vents associated with SVE air treatment systems
8. Confined space entry

B. The following procedures should be performed for all field activities:

1. Before the initiation of a specific field activity, the wind direction should be determined at the work location. Based on the determination of direction, the field crew should be appropriately located to allow the majority of work to be conducted upwind of the work location.
2. Ambient air measurements should also be taken in the breathing zone upwind of the organic vapor source and documented in the field logbook.
3. Next, ambient air measurements should be taken in the breathing zone within the work area or at the sampling locations. Document the measurements in the field logbook.
4. In some instances, air measurements should also be taken in the vicinity of or above the organic vapor source (i.e., top of well casing, sample location, borehole, etc.) within the guidelines of the SHSP. The SHSP will establish the action levels and proper personnel protective equipment to be implemented in the work area and/or in the vicinity of the organic vapor source.

2.4 DATA INTERPRETATION AND ACTION

2.4.1 Allowable Exposure Levels and Interpretation

- A. Upper limits of allowable vapor concentrations for personnel exposure should be established based on accepted health-based exposure limits

set by OSHA, NIOSH, or the ACGIH. For example, if a compound is present that has been assigned a NIOSH Threshold Limit Value (TLV - the maximum concentration to which a worker can be continuously exposed over an 8-hour workday), that concentration may be used as the limit of exposure above which respiratory protection is mandated. This maximum concentration shall also be within the reliable minimum threshold limit of the monitoring equipment. Therefore, the OSHA TWA of benzene (1 ppm) will be used in place of the 0.1 ppm NIOSH TWA value. In the absence of a TLV, a provisional maximum exposure limit concentration must be chosen. The limit should be based on available data on the toxicity of the compounds in question. The agency-based or provisional maximum exposure limit should be specified in the SHSP.

- B. If a specific compound of most concern is known to exist, and the DMI is calibrated for that compound, then the TLV for the compound should be used as the exposure limit. However, in most cases, numerous compounds of concern may be present simultaneously; therefore, the DMI should be calibrated with a compound most similar to those with the lowest established exposure limits, and the allowable exposure limit should correspond to the lowest TLV of the group.
- C. Because of the problems associated with mixed compounds and their possible synergistic effects, it is recommended that field exposure limits be set at one-half of the TLVs at sites where a thorough background screening and assessment of site compounds has not been performed.

Measurement Interpretation

- D. Measurements should be based on average sustained instrument readings of the ambient air over a time period specified in the SHSP. Typically, this period will be 5 minutes if the measured concentration is within 1 to 5 times the lowest TLV value.
- E. The DMI operator must use caution while monitoring the air quality because of the necessity to closely approach potential sources of contamination; levels near the source may be higher than ambient. Proper interpretation of the results of the DMI monitoring is essential. Wind direction, effect of exhaust from nearby vehicles or drilling rigs, and changes in upwind ambient conditions all must be considered when making air quality judgments. In addition, an elevated reading at the borehole opening or from auger cuttings does not necessarily imply that the ambient air quality has deteriorated to the point at which additional

safety precautions must be taken. Continued monitoring of ambient air quality is of prime importance.

- F. It is important that the monitoring personnel understand that each DMI's sensitivity varies for different compounds. Factors affecting this sensitivity include the calibration gas standard used, and for Photo Ionization Detectors (PIDs), the lamp ionization potential (eV). Some compounds may be able to produce readings many times higher than the same concentration of a different compound, hence the necessity of calibrating with the proper compound.
- G. The monitoring personnel should be aware of the relative response and sensitivities of the instruments to a compound with respect to the calibration standard. For instance:
 - 1. A Photoionization Detector (PID) device with a 10.2 eV lamp, calibrated to benzene, will measure concentrations of 11.2, 8.9, and 5.7 ppm, respectively, for m-xylene, trichloroethylene, and methyl ethyl ketone, when in fact, the concentration of each is 10.0 ppm. High humidity will further reduce the sensitivity of the device.
 - 2. A Flame Ionization Detector (FID), calibrated to methane, will measure concentrations of 111, 70, and 40 ppm, respectively, for m-xylene, trichloroethylene, and methyl ethyl ketone, when the concentration of each is 100 ppm. The relative responses range from 10 to 150 percent for the wide majority of volatile organic compounds found on hazardous waste sites.
 - 3. A Colorimetric Detector tube instrument will be used to test for hydrogen cyanide, hydrogen sulfide, benzene, hydrogen fluoride, and sulfur dioxide. This instrument is to be used to determine if these compounds are present. This instrument will be used to screen the breathing zone periodically and to confirm the presence of benzene if either the PID or FID show readings above background.
- H. The monitoring personnel should refer to relative response curves and sensitivity tables provided by the instruments' manufacturers.

2.4.2 Action Levels and Protection Response

- A. Action levels for respiratory protection should be specified in the SHSP, based on the allowable field exposure limits set for the particular

compounds of concern, considering the level and type of protection equipment available, the nature of the work, site history, exist locations, and the wind conditions.

- B. If the predetermined maximum allowable ambient level for vapors is exceeded, all work should be stopped, and personnel should be provided the appropriate level of protection. The SHSP should be reevaluated under these conditions by the Site Health and Safety Officer, and the Project Manager should be notified. If the ambient concentrations do not change, personnel will continue to work and implement the appropriate safety procedures.
- C. If concentrations decrease as to warrant the downgrade in respiratory protection levels, downgrading should be based on confirmatory readings taken over three consecutive 5-minute intervals before effecting the change.

Standard Operating Procedure No. 320

FIELD MEASUREMENTS

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 320 guidance for measurement of specific field parameters as described in the Work Plan or as otherwise specified. Water quality measurements are required during well development and groundwater sampling. Vapor headspace measurements are performed during screening of the soil samples.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Field methods to be used include measurements of the following:
 - 1. Temperature, pH, specific conductance, and turbidity
 - 2. Dissolved oxygen
 - 3. Vapor headspace measurement
- B. The site geologist or hydrogeologist is responsible for implementing the correct sampling techniques and for recording the field data and observations in the field logbook and/or field activity form.
- C. Field measurement devices shall be calibrated in accordance with the manufacturer's procedures or as specified in SOP No. 930.
- D. All field equipment shall be decontaminated after use in the field. Specific decontamination procedures are described in SOP No. 500.

2.2 PROCEDURES

2.2.1 Temperature / pH / Specific Conductance / Turbidity

Temperature, pH, conductivity, and turbidity meters shall be calibrated in accordance with the manufacturer's instructions and SOP No. 930.

Measurements shall be reported to the nearest 0.1° C for temperature, and to

the nearest 0.01 unit for pH. Conductance shall be reported to the nearest ten units for readings under 1,000 mhos/cm and to the nearest 100 units for readings over 1,000 mhos/cm. Turbidity shall be reported to the nearest ntu. All calibration and measurements shall be recorded in the field logbook and/or field activity form.

2.2.2 Dissolved Oxygen

Dissolved oxygen (DO) content of water samples shall be measured using a membrane electrode meter. The meter shall be calibrated in accordance with the manufacturer's instructions and SOP No. 930. DO content shall be reported to the nearest 0.1 mg/L. All calibrations and measurements shall be recorded in the field logbook and/or field activity form.

2.2.3 Vapor Headspace Measurement

A flame ionization detector (FID) or a photoionization detector (PID) will be used during field screening and headspace analysis of soil samples. The FID or PID should be calibrated in accordance with the manufacturer's instructions and guidelines in SOP No. 930. Vapor concentration measurements shall be reported to the nearest 1.0-ppm. Vapor headspace analysis procedures are provided in SOP No. 330. All calibrations and measurements shall be recorded in the field logbook and/or field activity form.

Standard Operating Procedure No. 330

VAPOR HEADSPACE SCREENING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 330 discusses the guidelines for conducting vapor headspace screening as described in the Work Plan or as otherwise specified. Through vapor headspace screening, organic vapor concentrations will be measured in all collected soil samples and will be used as criteria for selecting a soil sample for chemical analysis.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Headspace screening or analysis involves measuring the near-equilibrium vapor concentration with an unknown concentration of volatile organic compounds (VOCs) in a soil sample.
- B. The method involves placing a portion of a soil sample in a sealable plastic bag, sealing the bag, and allowing the test bag to equilibrate at room temperature for a predetermined length of time. The test bag is then punctured using the probe tip of an organic vapor detector (i.e., PID or FID) and the maximum vapor concentration is recorded.
- C. The method provides a quick and inexpensive way of determining the relative degree of contamination in a soil sample and providing criteria with which to select a sample for laboratory analysis. The method can be used to determine the relative horizontal and vertical extent of soil contamination.
- D. Organic vapor detection equipment should be calibrated before testing in accordance with the procedures provided in SOP No. 930.

2.2 SCREENING PROCEDURES

- A. Soil samples collected from split-spoon samplers should be placed in the test bag immediately after opening. Soil samples collected from the

surface, an excavation, or a soil pile should be obtained from a freshly exposed area and immediately placed in the test bag.

- B. Place approximately 4 ounces of sample into a one-quart test bag.
- C. Quickly seal the test bag. Write the sample location, sample number, and depth interval on the bag using a permanent marker or grease pencil. Allow the test bag to set for a minimum of 15 minutes at room temperature.
- D. Puncture the test bag with the organic vapor detector probe tip. Be careful not to insert the probe tip into the soil sample.
- E. Measure and record the maximum reading displayed by the organic vapor detector. Record the reading on the field activity form and/or field logbook. Erratic meter response may occur due to the presence of high vapor concentrations or excessive water vapor. If this occurs, the data should be disregarded.
- F. Discard the soil sample and test bag in a 55-gallon drum for subsequent disposal as specified in the Work Plan.
- G. The vapor headspace analysis should be performed the same day as the sample was collected.

2.3 EQUIPMENT AND MATERIALS

The equipment and materials required to conduct headspace screening are listed as follows:

- FID or PID with calibration kit
- Sealable plastic bag
- Permanent marker or grease pencil
- Field logbook

3.0 DOCUMENTATION

All headspace results should be recorded on the appropriate field activity reports and/or in the field logbook. Any conditions that may interfere with the headspace results (i.e., weather, water vapor, etc.) should also be noted.

Standard Operating Procedure No. 400

SEDIMENT, SLUDGE, AND WASTE SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 400 describes the guidelines for obtaining sediment, sludge, and waste samples as stated in the Work Plan or as otherwise specified. Sampling sediment, sludge, and waste is conducted for the purpose of chemical and physical analysis to evaluate and characterize waste sources.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Many of the same techniques that apply to soil sampling (SOP No. 200) also apply to the collection of sediment, sludge, and waste samples.
- B. Sediment, sludge, and waste samples are examined to evaluate the presence of contaminants in various waste sources such as ponds, impoundments, and tanks. Waste constituents may be liquid, semi-solid, or solid in nature. Sampling techniques will vary according to the physical characteristics of the material.
- C. If sediments, sludges, or wastes have the potential for being considered hazardous, disposable sampling equipment should be used.
- D. Sampling equipment for liquid materials typically consists of bailers, pails, and ladles. Semi-solid materials are usually collected using scoops, trowels, or dippers. Solid materials from relatively shallow depths can be collected with equipment used to collect soil samples such as scoops, trowels, hand augers, and coring tools.
- E. Sampling sediment and semi-solid waste material at depths greater than 10 feet are typically obtained using drilling methods (e.g., floating barges, all-terrain vehicles). Sampling methods are provided in SOP No. 200.

- F. Since sediment, sludge, and waste samples are collected in areas containing potentially high concentrations of hazardous waste, the appropriate health and safety guidelines should be followed.

2.2 SAMPLING EQUIPMENT AND METHODS

2.2.1 Trowels and Scoops

- A. This method provides a quick and simple means of collecting sediment, sludge, and waste samples that are partially disturbed.
- B. Insert trowel or scoop into material, remove sample, and place in the appropriate sample containers.
- C. If compositing a series of grab samples, collect samples from at least three different areas within the sampling area, and mix samples in a stainless-steel bowl or tray (except VOC samples). Transfer the composite sample in the appropriate sample containers.
- D. If the materials being sampled have been exposed to air, the upper 1 to 2 inches of material should be removed before sampling.

2.2.2 Hand Corers

- A. Hand corers or augers provide for the collection of a disturbed sample. Samples can be collected at depths up to 10 feet below the existing grade. The sampler can be adapted to hold liners consisting of brass, stainless steel, or plastic for collecting undisturbed samples. Care should be taken to select a liner that will not adversely impact the integrity of the sample.
- B. Hand corers or augers are typically used to collect semi-solid to solid materials.
- C. Twist and push coring device into medium being sampled to the desired sampling depth interval.
- D. Withdraw coring tool and remove sample from the auger head using a stainless-steel spatula or spoon. Place sample in the appropriate sample containers.
- E. Decontaminate sampling equipment in accordance with SOP No. 500.

2.2.3 Gravity Corers

- A. A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom of the core tube and a check or ball valve at the top. The gravity core also has four fins at the top of the core to maintain vertical penetration through the liquid and sampling media. The check valve allows liquid to pass through the corer as it descends into the sludge or sediment layer. Most corers are constructed of brass or stainless steel.
- B. The gravity corer collects undisturbed samples. The profile or layering that may develop in the sediment or sludge is retained for observation and measurement.
- C. Depending upon the texture and consistency of the sediment or sludge, penetration of up to 30 inches can be achieved from the gravity-coring device.
- D. Attach a known length of the sample line to the end of the gravity-coring device. The sample line should consist of braided nylon rope.
- E. Secure the free end of nylon rope to a fixed support to prevent losing the coring device.
- F. Measure the marked distance to the top of the sludge or sediment layer to determine the approximate depth of penetration. Allow enough sample line to adequately penetrate the sludge or sediment.
- G. Let the coring device free fall through the liquid, if present, into the sludge or sediment layer. Determine the depth of sample penetration from the length of sample line.
- H. Retrieve the coring device carefully. Do not bump the coring device on the sides or walls of the storage unit to prevent sample loss.
- I. Remove the nosepiece or sample catcher from the coring device and slide sample on an aluminum or stainless steel tray. Describe physical characteristics of the sample (i.e., color, water content, sediment size, etc.) and record in the field logbook.
- J. Transfer the sample into appropriate sample containers.
- K. Decontaminate the coring device in accordance with SOP No. 500.

2.2.4 Ponar Grab Sampler

- A. Ponar or clamshell type samplers are typically used to collect disturbed samples of sludges and sediments ranging from silt to granular materials. The samplers vary in size and weights.
- B. The sampler consists of a spring-loaded scoop activated by a center-lever system. The shell is opened and latched in place, and slowly lowered to the bottom. When tension is released on the sample line, the latch is released and the clamshell closes, collecting a portion of sample from the bottom.
- C. Attach a known length of sample line, as described above, to the ponar sampler.
- D. Open the sampler until the sample jaws are latched.
- E. Lower the sampler slowly down through the liquid, if present, to the top of the sampling medium. The sampler will be triggered, and the jaws will close upon impact with the sample medium.
- F. Slowly retrieve the sampler and allow excess liquid, if present, to drain away.
- G. Place the sample on an aluminum or stainless-steel tray.
- H. Transfer the sample into the appropriate sample containers.
- I. Decontaminate the sampler in accordance with SOP No. 500.

2.2.5 Bacon Sampler

- A. A bacon sampler consists of a nickel-plated brass cylindrical body (2-inch-diameter) that is threaded for upper and lower covers. The lower cover is tapered with a plunger that acts as a valve to admit samples. The lock on the upper cover keeps the plunger closed after sampling. The upper cover has guide holes where the drop cord and a line for controlling the plunger lock can be attached. The sampler's net weight is 2 pounds (0.9 kg).
- B. The bacon sampler can retrieve an 8-ounce sample of sludge, sediment, asphalt, or liquid from various levels within a storage tank.
- C. Attach a known length of drop cord to the guide hole on the upper cover of the sampler. Attach another line to the plunger lock guide hole.

- D. Lower the sampler to the desired depth and release the plunger lock line to collect the sample. After collecting the sample, close the plunger lock and retrieve the sampler.
- E. Open the lower cover or release the plunger lock and transfer the sample into the appropriate sample containers.
- F. Decontaminate the sampler in accordance with SOP No. 500.

2.4 SAMPLE HANDLING AND SPECIMEN PREPARATION

- A. Samples will be handled, classified, stored, packaged, and shipped in accordance with SOP No. 911.
- B. Samples will be placed in appropriate sample containers as specified in the Quality Assurance Project Plan (QAPP) and in accordance with SOP No. 912.
- C. Sample handling and packaging will be in accordance with the site Health and Safety Plan.

3.0 DOCUMENTATION

- A. Record sample data and field observations in accordance with requirements specified in SOP No. 120.
- B. Document the sample location(s) in the field logbook and/or the listed activity form. Mark the sample location(s), if possible, with a wooden stake and measure the sample location(s) in reference to a permanent site feature on a scaled map.
- C. Specific documentation procedures for sample classification and chain of custody control should be conducted in accordance with SOP Nos. 911 and 912.
- D. Document decontamination procedures.

Standard Operating Procedure No. 410

GROUNDWATER SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 410 describes the guidelines for obtaining groundwater samples from monitoring wells, recovery wells, or observation wells as described in the Work Plan or as otherwise specified for the purpose of determining groundwater quality.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Decontaminate all sampling instruments as specified in the FSP and in accordance with SOP No. 500.
- B. Provide sufficient quantity and type of sample containers at the groundwater sampling location. Sample bottle sizes, preservation techniques, quantity, and other specifics are outlined in the Quality Assurance Project Plan (QAPP). Sample Classification, storage, packaging, and shipment will be conducted in accordance with SOP No. 911.
- C. Field measurements including pH, temperature, specific conductance, and turbidity of each well volume will be performed before sampling. Field measurements are discussed in detail in Section 3.4 of the FSP and SOP No. 320.
- D. The first water sample collected will be for volatile organic analysis (VOC). The sample vials should be filled with as little agitation as possible as it passes from the sampling device to the sample bottle. There should be no air bubbles present in a VOC sample vial. Other sample bottles can then be filled and preserved as specified in the FSP and QAPP.
- E. Trip blank samples supplied by the laboratory, along with the sample bottles, will be used as discussed in SOP No. 920 and the QAPP.

2.2 FIELD MEASUREMENTS

2.2.1 General

- A. Measure and record depth to water in wells and calculate standing water volume in the well.
- B. Record physical characteristics of the water sample in the field logbook and/or field activity forms. The physical characteristics include color, general turbidity, odor, viscosity, and other observations.
- C. Measure and record water quality parameters of the water sample in the field logbook and/or field activity forms. The water quality parameters include:
 - 1. pH
 - 2. Temperature
 - 3. Specific conductance
 - 4. Turbidity
- D. Temperature, specific conductance, pH, and turbidity measurements are used to determine when the purging process is completed and representative groundwater from the aquifer is present in the well.
- E. Due to the nature of most field measurement devices, it is difficult or impossible to decontaminate them thoroughly and so they should not enter the well directly. Therefore, samples for field measurements should be taken from the purged water. Care should be taken not to contaminate the field measurement equipment with material that cannot be safely rinsed off.
- F. Field instruments should be calibrated before sampling. Calibration procedures for field instruments should be followed in accordance with SOP No. 930.

2.2.2 Field Measurement Procedures

The following field measurements should be performed and noted in the bound field logbook and/or field activity form:

- A. Physical Measurements
 - 1. Well number and location
 - 2. Diameter and construction material of the well casing.

3. Total depth of well from the top of casing (TOC), surveyor's mark, if present.
4. Depth from top of casing to water (DTW).
5. Calculate the linear feet of water in the well/borehole by subtracting depth to water from total depth of well/borehole. The capacity of various well casing/borehole diameters are as follows:

Casing or Borehole Diameter	Gallons / Linear Feet
2"	0.16
4"	0.66
6"	1.47
8"	2.61
12"	5.81

Now calculate the standing water volume (V) present in the well casing and filter pack as follows:

$$V = nA (B-C) + CD$$

where,

n = porosity of the filter pack (usually 0.25)

A = height (in feet) of the saturated filter pack

B = volume (in gallons) of one linear foot of borehole

C = volume (in gallons) of one linear foot of well casing

D = height (in feet) of the standing water column in the well

B. Water Quality Parameters

In addition to the physical measurements described above and other information that may identify the well, record the following water quality parameters for each well volume removed before sampling:

1. pH
2. Temperature
3. Specific conductance
4. Turbidity

2.3 WELL PURGING AND EVACUATION PROCEDURES

2.3.1 General

- A. In order to obtain a representative groundwater sample, the water that has stagnated and/or thermally stratified in the well casing should be purged or evacuated. This evacuation procedure allows fresh or formation groundwater to enter the well. A minimum of three well volumes should be evacuated or until the water quality parameters stabilize in high-yield wells. In wells with very low recoveries, the well may be evacuated to near dryness and allowed to recover before sampling.
- B. Criteria for parameter stabilization include:
 - 1. pH, ± 0.1 unit
 - 2. Temperature, ± 0.5 C
 - 3. Conductivity, $\pm 15\%$
 - 4. Turbidity, $\pm 10\%$
- C. All newly constructed wells should be allowed to stabilize for a minimum of 48-72 hours before sampling. Additionally, once a well is evacuated, it should be sampled within 2 hours. If an evacuated well is allowed to sit longer than the prescribed 2 hours, it should be re-evacuated as the water contained in the well casing may no longer be representative of aquifer conditions.

2.3.2 Evacuation by Pumping

- A. Extreme caution should be exercised to ensure that this evacuation procedure does not cause cross-contamination from one well to the next. Therefore, dedicated tubing and pumps are preferred. If it is not practical to dedicate a pump to a specific well, it is permissible to decontaminate this equipment. The pump may be reused to sample monitoring wells installed at the same waste handling unit. Equipment should be decontaminated in accordance with SOP No. 500. Tubing should always be dedicated and never used for more than one well. Wash and rinse the pump and collect a sample of the rinse water as a field blank to ensure the integrity of the sample.
- B. During evacuation, set the pump intake not greater than 6 feet below the dynamic water level in the well. This requires that the evacuation device may have to be lowered as purging continues.

- C. During pumping, intermittently collect pump discharge in a container of known volume for a period of not less than 2 minutes to verify the pump flow rate and to check the purged volume.
- D. Measure the temperature, conductivity, pH, and turbidity after each required well casing volume and intermittently thereafter until field measurements are consistent with the stabilization criteria variances, listed above, for each parameter.
- E. Collect purged well water in drums, buckets, or suitably sized containers for subsequent disposal as specified in the Work Plan.

2.3.3 Evacuation by Bailing

- A. Hand bailing should be utilized when static water levels are greater than 25 feet or if no submersible pump is available. However, care should be exercised to prevent introduction of contaminants into the well and causing excessive aeration of the water sample.
- B. For dedicated bailers, wash and rinse the bailer before purging if contaminants, foreign matter, or rust are present. For non-dedicated bailers used at more than one well, decontaminate the bailer in accordance with SOP No. 500.
- C. Evacuate a minimum of three well volumes by repetitive bailing and until water quality parameters stabilize.
- D. Collect purge water in 55-gallon drums or as specified in the Work Plan.

2.4 SAMPLING EQUIPMENT

Equipment to be used for groundwater sampling generally falls into two categories: those used to evacuate the well casing and those used to collect a discrete sample for analysis. In some instances, the device used for evacuation may also be used for sample collection. In many instances, however, characteristics exhibited by the evacuation device may preclude its use for sample collection. Types of equipment available for evacuation and/or sampling include the following:

- 1. Bottom fill bailers
 - a. Single check valve (bottom)
 - b. Double check valve (top and bottom)
 - c. Polyethylene, polypropylene, PVC, or Viton® construction

- d. Teflon construction
 - e. Stainless steel construction
 - f. Stainless steel construction with Teflon check valve(s)
2. Suction lift pumps/centrifugal pumps
 3. Portable submersible pumps
 4. Bladder (gas squeeze) pumps
 5. Continuous organics sampling system in conjunction with peristaltic pump

Hand bailers come in a variety of sizes and volumes to accommodate most well casing diameters. The preferable materials of construction are, in order of decreasing preference, Teflon, stainless steel, polypropylene, polyethylene, Viton®, PVC (low plasticizer content).

In addition to an evacuation and sampling device, other pieces of equipment and supplies necessary for sampling include:

1. Steel tape and chalk or electronic water level indicator
2. Sample containers
3. Preservatives, as needed
4. Ice or ice packs
5. Field instrumentation, as needed
6. Trip blanks
7. Bound field logbook
8. Sample analysis request forms
9. Chain of custody forms and custody seals
10. Sample labels, indelible
11. Appropriate personal protective equipment
12. Appropriate hand tools
13. Keys to locked wells, if needed
14. Water filtration device and disposable filters, if necessary

Field equipment for sampling, evacuation, and field measurements should be as specified in the FSP.

2.5 SAMPLING METHODS

2.5.1 Bottom-fill Bailer

- A. After evacuation of the required volume of water from the well, proceed with sampling as soon as possible after evacuation, preferably

immediately. In most cases, the time lapse between evacuation and sampling should not exceed 2 hours.

- B. The type of bailer used for sampling will depend on the required quality of gathered information.
- C. The bailer and any other equipment entering the well should be properly decontaminated and handled with new surgical gloves to preclude any potential contamination sources. Nothing entering the well should be allowed to contact the ground or any other potentially contaminated surfaces (i.e., gasoline pumps). If this should occur, that item should not be placed in the well or used for sampling. It is always a good practice to have an extra clean bailer on hand in the case of an emergency. Plastic sheeting should also be placed around the well to preclude any contact of equipment with the ground surface.
- D. Lower the bailer by hand using either a stainless steel cable or a new length of nylon rope. Hand bailers should be lowered into the well using caution not to aerate the well water to be sampled. Lower the bailer to the well screen interval and pull up the rope. Retrieve the bailer and slowly transfer the sample to the appropriate sample containers, filling VOC vials first. If onsite filtration is required, extra quantities of sample should be collected.

2.5.2 Suction Lift Pumps/Centrifugal Pumps

- A. Suction lift pumps (i.e., diaphragm, peristaltic, and centrifugal) are pumps used at the ground surface with polyethylene tubing inserted into the well. They are used to evacuate the well before sampling. The tubing should be new and dedicated to a particular monitoring well, and equipped with a valve that will prevent the aerated water from falling back into the well. The pump casing should be rinsed with tap water, then distilled water, between sampling points.
- B. The limitation posed by this type of pump is its suction capability. Generally, the groundwater level should be less than 25 feet below the ground surface.
- C. Due to the nature of these pumps, as well as their effect upon samples for chemical analysis, these devices should be used only for well evacuation and not groundwater sampling unless otherwise specified in the FSP.

2.5.3 Portable Submersible Pumps

When the groundwater level is greater than 25 feet, the use of suction lift pumps is prohibited, and another evacuation device should be used. If the diameter of the well casing allows, a portable submersible pump can be used. Due to the nature of these pumps, as well as their effect upon samples for chemical analysis, these devices should be used only for monitoring well evacuation and not groundwater sampling unless otherwise specified in the RP&S.

2.5.4 Bladder Pumps (Gas Squeeze Pumps)

- A. A bladder pump consists of a stainless steel housing that encloses a flexible membrane. Below the bladder, a screen is attached to filter any material that may clog the check valves located above and below the bladder. The pump works as follows. Water enters the membrane through the lower check valve. Compressed gas is injected into the cavity between the housing and bladder. The water moves through the upper check valve and into the discharge line. This upper check valve prevents back flow into the bladder.
- B. The bladder pump is used much like the portable submersible pump, except that no electrical lines are lowered down the well. The source of gas for the bladder is either bottled air or an onsite air compressor. Disadvantages include the large gas volumes needed, potential bladder rupture, and difficulty in cleaning the unit.

2.5.5 Potable Well Sampling Procedure

- A. The first step in sampling a potable well, whether it be a homeowner's well or a municipal production well, is to obtain as much information as possible from the homeowner or water superintendent. This should include: depth of the well, formation in which it is completed, screen depth and length, diameter of casing, and when and who installed it. Caution should be used in applying this information unless confirmation can be obtained (i.e., drilling logs).
- B. With this information, determine the number of gallons to be evacuated. If no information is available, evacuate for a minimum of 15 minutes. This evacuation is best accomplished from an outside faucet with a hose run away from the home. In this manner, overloading of the homeowner's septic system will be minimized.

- C. An inspection of the system should be performed to locate the well, pump, storage tanks, and any treatment systems that may be present. The sample access point should be chosen as close to the well head as possible, before the storage tank or any treatment devices. Collect that sample at the first tap or spigot and note in the field logbook where the sample was collected, and any systems (storage and/or treatment) between the well head and sample collection point. For long-term monitoring projects, a specific tap or faucet could be designated as the sample access point and used for the duration of the project.

3.0 SAMPLE HANDLING

- A. Groundwater samples should be placed in appropriate sample containers and preserved in accordance with SOP No. 910 and the QAPP.
- B. Groundwater samples should be classified, stored, packaged, and shipped in accordance with SOP No. 911 and the QAPP.
- C. Sample control and chain of custody protocol should be in accordance with SOP No. 912 and the QAPP.

4.0 DOCUMENTATION

The location of the well, physical characteristics, well evacuation volume, and water quality parameter measurements should be recorded on the groundwater data form (see Attachment 1) and/or the field logbook. Documentation procedures should be in accordance with SOP No. 110.

ATTACHMENT 1

GROUNDWATER DATA FORM

GROUNDWATER DATA FORM

PROJECT INFORMATION															
EVENT		Well Development		Groundwater Sampling		Low-Flow Groundwater Sampling									
Project Name												Well ID			
Project No.												Start Date			
Field Personnel												End Date			
WELL AND DEVELOPMENT / PURGE INFORMATION															
Casing ID						Purging Method						Tube/Pump Intake Depth			
Screened Interval						Pump Make, Size, or Type						Pump Rate			
DEPTH MEASUREMENTS								VOLUME PRODUCTION INFORMATION							
				INITIAL		FINAL		Volume Type:				Borehole		Well Casing	
				Depth	Time	Depth	Time	Linear Feet of Water in Well							
Product								Amount Equal to One Volume							
Groundwater								Total Volumes Produced							
Casing Base								Well Purged Dry?							
NOTES:															
PHYSICOCHEMICAL PARAMETERS															
Date	Time (24 hour)	Flow Rate (____)	No. of Vol Removed (#)	Volume Purged (gal)	Depth to Water (ft BTOC)	Drawdown (ft)	Temp (° C)	pH	Conduct. (mS/cm)	TDS (ppm)	Dissolv. Oxygen (ppm)	Eh (mV)	PID (ppm)	Turbid. (ntu)	Visual Clarity

Standard Operating Procedure No. 500

EQUIPMENT DECONTAMINATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 500 describes the guidelines for decontamination of personnel and equipment during hazardous waste investigation field activities as specified in the Work Plan or as otherwise specified.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. A decontamination plan should be developed and sufficiently scoped to address all the expected types and levels of contaminants at the site and the methods used to investigate them. Until proven otherwise, the decontamination plan should assume that all personnel and equipment exiting the area of potential contamination are contaminated and, therefore, comprehensive decontamination procedures must be implemented. Procedures for decontamination of equipment, as well as personal protective clothing and safety equipment, are included in the Site Health and Safety Plan (SHSP).
- B. Personnel involved in decontamination efforts will be equipped with the same protective equipment as those conducting onsite investigations until a lower level of risk can be confirmed.
- C. Procedures for decontamination of field personnel should be specifically addressed in the SHSP. These procedures should be followed and incorporated with the equipment decontamination procedures contained in the FSP to minimize exposure and cross-contamination potential.
- D. Decontamination activities should be documented to verify that proper procedures are followed. Documentation shall be in accordance with the requirements specified in SOP No. 110, the Work Plan, and/or Quality Assurance Project Plan (QAPP).
- E. The methods described in this SOP are considered sufficient for most hazardous waste investigations. However, more intensive site-specific

procedures may be required under highly toxic or other “non-routine” conditions. In these cases, advice of in-house or consulting industrial hygienists and/or organic chemists may be of assistance in determining specific procedures necessary for decontamination.

- F. Decontamination procedures may be subject to federal, state, local, and/or the client’s regulations. All regulatory requirements must be satisfied, but the procedures adopted should be no less rigorous than those presented in this SOP.
- G. Climatic conditions anticipated during the decontamination activities may play a significant factor in the procedures selected. Special facilities may be needed to compensate for weather conditions, such as temporary heated structures for winter work and windscreens for dust prevention. It may be necessary to establish special work conditions during periods of high heat stress.

2.2 SITE FACILITIES AND SUPPLIES

2.2.1 Site Selection

- A. The equipment decontamination facility should be in an area where contaminants can be controlled and at the boundary of a “clean” zone. The location should also be selected to prevent equipment from being exposed to additional or other contamination. On large projects, a formal “Contamination Reduction Zone” should be established in which all decontamination efforts will be conducted. This area should be conspicuously marked as “off-limits” to all personnel not involved with the decontamination process.
- B. Due to the volume of wastewater generated the equipment decontamination area should be located where decontamination fluids can be easily discharged into adequate storage containers, followed by characterization and proper disposal.
- C. The decontamination area should have adequate storage area for storing unused drums, used drums containing spent decontamination fluids and waste, and trash containers, until such time that they can be relocated or disposed offsite.

2.2.2 Decontamination Pad

- A. Some sites under investigation may have an existing decontamination area. If an area has previously been constructed, it should be evaluated

for logistics capabilities such as water supply, electrical power, by-product handling capabilities, and cleanliness. If the existing area can be used or modified for use, the savings in costs and level of effort may be significant.

- B. On small projects where only hand sampling or other small equipment is being used, several small washtubs (filled with detergent and potable water) may be sufficient for decontamination.

2.2.3 Water Supply

- A. Large volumes of water, often exceeding 1,000 gallons per day, may be required for cleaning, especially for drill rigs and other large equipment. The water used for equipment decontamination must be clean, potable water; municipal water supplies are generally adequate.
- B. Stainless steel tank trucks or aluminum (if stainless steel is not available) can be used for onsite storage of the water supply. These tankers can be transported easily and are not excessively expensive. Typically, a week's supply of water can be stored onsite.
- C. Water may also be stored in open-top watertight tanks or roll-off boxes located in the clean zone on the site. However, open-top tanks or box containers should not be used if airborne contaminants are present, unless a liner is used to cover the container. Containers should be steam-cleaned and acid-washed before use. Only containers used to store fresh water or inert materials should be used. Never use containers previously used to store petroleum products or organic chemicals.

2.2.4 Cleaning Equipment and Supplies

- A. A portable steam cleaner or high-pressure hot water washer is normally required to clean contaminated heavy machinery (e.g., drill rig, backhoe, etc.) as well as materials and associated tools. Most washers and steam cleaners are commercially available for both portable generators or supplied AC power. Site logistical considerations may control the type of equipment required.
- B. Typical steam cleaners/washers operate on relatively low water consumption rates (2 to 6 gpm) and can be used in conjunction with other cleaning fluids mixed with the water. High-pressure steam is preferred to high-pressure water because of steam's greater ability to volatilize organics and to remove oil and grease from equipment.

- C. Units tend to malfunction easily and are susceptible to frequent maintenance and repair (especially under frequent use or use below freezing conditions). If possible, a second or back-up unit should be available onsite or arranged for with a nearby vendor.
- D. On some small projects, garden sprayers may be used for final rinsing or cleaning. Typically, these sprayers are limited to use with small hand tools or sampling equipment. They also tend to break down and malfunction quickly.
- E. Miscellaneous items required for decontamination efforts include some of the following:
 - Potable water supply
 - Decontamination solution
 - Potable water
 - Distilled water
 - Mild detergent (such as Alconox)
 - Isopropanol
 - Brushes to remove heavy mud, dust, etc.
 - Buckets
 - Steam cleaner or high-pressure, hot water washer
 - Racks normally metal (not wood) to hold miscellaneous equipment such as drill rods, sampling tools, etc.
 - Utility pump to collect spent fluids for containerizing
 - Drums to store contaminated materials (personal protective equipment, etc.)
 - Tables (not wood) to hold small items after/during cleaning
 - Plastic sheeting to wrap decontaminated equipment, tools, etc., after cleaning

2.3 EQUIPMENT AND VEHICLE DECONTAMINATION PROCEDURES

- A. The following procedures are presented as a function of the level of contaminant concentration and are intended as general guidelines. Appropriate site procedures should be established based on the individual site characteristics and type of investigation prescribed.
1. Low to Moderate Contaminant Concentration:
 - a. Steam or water rinse with potable water to remove mud or dirt
 - b. Steam or hot water wash with a mixture of detergent and potable water
 - c. Steam or hot water rinse with clean, potable water
 - d. Air dry
 2. High Contaminant Concentration:
 - a. Steam rinse with potable water to remove mud or dirt.
 - b. Steam wash with a mixture of detergent and potable water or other type of decontamination solution.
 - c. Steam rinse with clean, potable water.
 - d. Air dry.
- B. During decontamination of drilling equipment and accessories, clean hollow-stem auger flights, drill rods, and drill bits (particularly roller bits), as well as all couplings and threads. Generally, decontamination can be limited to the back portion of the drill rig and those parts that come in direct contact with samples or casing, or drilling equipment placed into or over the borehole.
- C. Some items of drilling equipment cannot typically be decontaminated; these include wood materials (planks, etc.), porous hoses, engine air filters, etc. These items should not be removed from the site until ready to dispose of in an appropriate manner.
- Other drilling equipment (especially rotary drill rigs) that requires extensive decontamination are water or grout pumps. Flushing may be sufficient to clean them. However, if high concentration of constituents or visible product is known to exist, then disassembly and thorough cleaning of internal parts is required before removal of the equipment from the site.
- D. The mud pumps, kelly, swivel, and suction hoses on rotary drill rigs should be cleaned by circulating a minimum of 1,000 gallons of clean water and cleaning solution through the system followed by a minimum of

200 gallons of clean water through the system, and finally rinsing with 50 gallons of clean water without recirculating the fluid.

2.4 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

- A. All sampling equipment that may contribute to the contamination of a sample must be thoroughly decontaminated before its initial use, unless specific documentation exists that the sampling equipment has been decontaminated.
- B. Generally, sampling equipment can be cleaned by hand. The following procedure is given as a typical sequence that should be modified based on site conditions.
- C. Split-spoon and Shelby-tube samplers, bailers, and other sampling equipment that can be cleaned by hand shall be decontaminated as follows:
 - 1. Wash and scrub with detergent (non-ionic)
 - 2. Tap water rinse
 - 3. Air dry

Rotasonic sample core barrels will be decontaminated by flushing the interior of the barrel with tap water in between samples collected from the sample boring, and high-pressure steam washing the core barrel between boring locations.
- D. Steel tapes, water probes, transducers, thermometers, and water quality meters shall be rinsed in distilled water or cleaned in a detergent solution and rinsed in distilled water after each use.
- E. All pumps will be cleaned in water/detergent solution, followed by a tap water rinse, and flushed with distilled water after each use.
- F. Use of high-pressure steam or hot water washing may be substituted for hand scrubbing if it effectively removes contaminants and soil and can be done safely without burning or contaminating the personnel. Special racks should be used to hold equipment while high-pressure washing. High-pressure washing should not be conducted on delicate equipment.
- G. More "complicated" samplers require more "complicated" decontamination procedures. Piston and other samplers with numerous internal parts should be avoided, if possible, on sites requiring extensive decontamination procedures.
- H. To the extent possible, tubing shall be either dedicated to a particular well/location or disposed of after each use. Tubing that cannot be

dedicated to a particular well/location or disposed of shall be cleaned in water/detergent solution, followed by a tap water rinse, followed by a distilled water rinse. Sufficient rinse water shall be used to flush out all the wash water and tap water rinse.

2.5 WELL MATERIALS DECONTAMINATION PROCEDURES

Well-casing, whether constructed of PVC, stainless steel, or other materials will be cleaned with a steam cleaner or high-pressure hot-water washer before it is installed. All well construction materials will be handled while wearing latex gloves.

2.6 DISPOSAL PRACTICES

2.6.1 General Disposal Requirements

- A. Proper disposal of decontamination, sampling, and drilling byproducts shall be conducted to prevent the spread of contaminants offsite and to protect individuals who may encounter the potentially hazardous materials.
- B. Disposal practices shall be in accordance with the procedures specified in the Work Plan. In general, sampling, drilling, and decontamination byproducts should be collected and disposed in a manner consistent with the accepted disposal practices for the type and concentration of wastes that may be contained in the byproducts.
- C. Contaminated equipment or solutions will not be discarded in any manner that may lead to contamination of the environment by the migration of hazardous constituents from the site by air, surface, or subsurface transport mechanisms.

2.6.2 Onsite Disposal

- A. Certain materials that are not contaminated or contain very low levels of contamination may be disposed of onsite. Such materials may include drill cuttings, wash water, drilling fluids, and water removed in developing or flushing wells. The low level of contamination in these materials should be confirmed before onsite disposal.
- B. On controlled, secured facilities, most contaminated materials may remain on the site, provided they do not pose a threat of contamination of personnel or areas to be sampled.

2.6.3 Offsite Disposal

- A. Materials that cannot be disposed of onsite will require that specific procedures be developed to provide for offsite disposal. Storage areas and/or tanks will be provided to hold the material onsite before disposal. Offsite disposal may be appropriate at various locations depending upon the nature of the waste. Prior to transporting the storage containers offsite, steps should be taken to ensure that the containers are properly sealed and labeled.
- B. Consideration should be given to use of sanitary and storm sewer systems, sanitary landfills, and licensed hazardous waste disposal facilities. Offsite disposal of wastes must comply with local, state, and federal laws and regulations. The Work Plan should identify the waste disposal options appropriate for offsite disposal of various classes of waste materials.

Standard Operating Procedure No. 910

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 910 describes the guidelines for preparation of sample containers, preservation of samples, and sample holding times as required in the Work Plan or as otherwise specified. This sampling protocol will be implemented to maintain the quality and integrity of the samples to be analyzed.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Sample containers and preservation methods should be selected and used to ensure the accuracy and validity of chemical and physical analyses. Materials or procedures that might cause overt disturbance, contamination, oxidation or other chemical decomposition or reaction of the sample should be avoided. This SOP addresses only containers and preservation of chemical analytical samples.
- B. Sample preservation methods should adequately meet the requirements established in the Work Plan or QAPP.
- C. Use of containers and preservation procedures should be consistent with the analytical procedures used by the analytical laboratory.
- D. Preservation is generally limited to pH control, addition of chemicals, and refrigeration. These techniques are intended to retard biological action, retard hydrolysis of chemical compounds, keep metals in solution, and reduce volatility of constituents.
- E. Hazardous samples (those that contain medium or high concentrations of contaminants) should not be prepared with any chemical preservative or cooled, except as specifically required for samples of known contaminant type.

- F. Refrigeration to maintain the sample temperature at $4 \pm 2^{\circ}\text{C}$ is the minimum amount of preservation that should be performed for environmental samples. Samples should not be frozen, and dry ice should not be used as the cooling agent (due to shipping restrictions). Chemical preservatives may be added to sample bottles in advance, either by the testing laboratory or by field personnel. The recommended preservatives for various constituents are presented in the QAPP.
- G. Certain constituents may deteriorate within a given time span regardless of preservation. Based on the best available data, recommended maximum holding times for many constituents have been determined and are listed in the QAPP.
- H. If, under any circumstances, the proper preservation technique is not used or if the recommended holding time is exceeded, the data as finally reported by the laboratory must indicate the particular variance.
- I. Volumes of sample required for analysis vary widely depending on type of chemical analysis. The volumes required for a particular analysis are listed in the QAPP.
- J. Sample bottle lids should be hand-tightened. The lids should not be taped as some tapes may contain chemicals that could contaminate the sample.

2.2 CONTAINER TYPES

- A. Containers in which samples of soil or water are collected should be constructed of materials that remain inert with respect to the suspected contaminants. Amber glass and linear polyethylene (LPE) containers are recommended. They should have screw-type lids to assure adequate sealing of the bottles. Teflon inserts should be placed inside the lids of glass containers to prevent sample reaction to the lid and improve the quality of the seal.
- B. The volumes of the containers used in sample collection are dependent upon the analytical requirements.
- C. Sample containers should generally be supplied by the laboratory contracted to perform the analyses. In these cases, sample bottles should be cleaned by the laboratory before shipment to the field. If this procedure has been followed, each bottle should be clearly labeled as to the type of sample it should contain (e.g., metals, TOC, etc.).

2.3 CONTAINER AND PRESERVATION REQUIREMENTS FOR ENVIRONMENTAL SAMPLES

2.3.1 Water Samples

Organics

- A. Water samples for volatile organic compounds (VOCs) should be collected in 3-40 mL glass vials preserved with hydrochloric acid (HCl), equipped with Teflon-backed, silicon septum screw caps and filled to the top with no visible air bubbles. Water supply and other samples also suspected of containing residual chlorine should have 0.008 percent $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulfate) added. These water samples should be preserved by cooling with ice to 4 +/- 2 °C and other preservatives as specified by the contracted laboratory, immediately after sample collection.
- B. Regulatory or other considerations may require that trip blanks be collected for volatile organic compounds (VOCs). Trip blank samples for VOC analysis should be collected in 40 ml glass vials (purge vials), preserved with hydrochloric acid (HCl), equipped with Teflon-backed, silicon septum screw caps and filled to the top with no visible air bubbles.

Metals

- C. Water samples for metals analysis should be collected in one-liter high-density polyethylene bottles with solid polyethylene or polyethylene-lined caps. Bakelite caps should be avoided. The bottles are cleaned with dilute nitric acid and washed well with distilled or deionized water. The samples should be preserved with nitric acid to below pH 2. Nitric acid concentration should not exceed 0.15 percent if the sample is to be shipped via air cargo.

2.3.2 Soil or Sediment Samples

If Method 5035 preservation techniques are to be used for the collection of soil samples for VOC analysis, each sample will be placed in 2-40 mL vials preserved with sodium bisulfate (low level analysis), 2-40 mL vials preserved with analyte-free water (alternate low level analysis), 1-40 mL vial preserved with methanol (high level analysis), and 1-2 oz. jar. In order to minimize the physical disruption of the sample, disposable plastic syringes are used to collect soil from the most undisturbed soil (typically the center of the soil core) and

placed it into the sample vials. Samples should be preserved by cooling with ice or refrigeration at 4 +/- 2° C, immediately after sample collection.

2.4 PRESERVATION PROCEDURES FOR UN-ANALYZED HAZARDOUS SAMPLES

2.4.1 Liquids and Solids, Excluding Samples from Closed Containers

Both liquid and solid samples should be placed in glass jars with Teflon-lined screw cap lids. Eight-fluid-ounce wide-mouth round jars of clear glass are recommended. These bottles can be centrifuged to facilitate phase separation in the laboratory before analysis. These samples are not treated with chemical preservatives or cooled.

2.4.2 Liquids and Solids from Closed Containers

Samples from closed containers must, unless clear evidence to the contrary is present, be handled as if Poison A is present. Such samples should be placed in 40 ml or similar glass bottles with Teflon-lined caps. The sample container must be small enough to fit through the valve hole of a DOT specification metal cylinder for packaging and shipping in accordance with DOT regulations. These samples are not treated with chemical preservatives or cooled.

2.5 SAMPLE HOLDING TIME

Liquid and soil samples should be submitted to the laboratory within the required holding time as specified in Table 18 of the QAPP. Failure to analyze the samples within the specified holding time will compromise the integrity and validity of the analytical data.

Standard Operating Procedure No. 911

SAMPLE CLASSIFICATION, STORAGE, PACKAGING, AND SHIPMENT

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 911 describes the guidelines for sample classification, storage, packaging, and shipment as described in the Work Plan or as otherwise specified to ensure proper handling of samples.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Classification of samples shall be made based on the suspected level of contaminant concentration. This will determine subsequent packaging and labeling requirements, shipping procedures, and laboratory handling of samples.
- B. Contamination concentrations must be assessed early in the planning stage of an investigation because of their effect upon field operation.
- C. Sample classification must be considered in the development of the Site Health and Safety Plan (SHSP). The procedures and materials used for sample packaging must adequately protect the sample container from accidental breakage and should be sufficient to prevent any leaks or spills.
- D. Sample labels for proper sample identification should be in accordance with the QAPP. The correct labels must be applied to sample containers and shipping containers to conform to U.S. Department of Transportation (DOT) and current ICAO/IATA shipping regulations.
- E. Samples classified as hazardous can be shipped only by means specified in the DOT regulations and as discussed herein.

2.1.1 Sample Classification

2.1.2 Environmental Samples

- A. Environmental samples are those that contain less than 10 ppm of any one contaminant. Samples collected offsite are considered “environmental” unless information to the contrary exists. Onsite samples may be classed as “environmental” by the Consultant Site Manager or Contractor based on knowledge of the site and nature of the sample.
- B. Initially, concentrations of constituents are estimated based on knowledge of contaminant sources and the contaminant transport mechanisms, and their effects on contaminant concentrations. It is, therefore, necessary to be conservative in the estimate of contaminant concentration. Sample classification can be downgraded for subsequent samples if data exist to support that decision.

2.1.3 Hazardous Samples

- A. Two categories of hazardous samples are defined as follows:
 - 1. Medium concentration - samples expected to contain greater than 10 ppm and up to 15 percent (150,000 ppm) concentration of any one contaminant.
 - 2. High concentration - samples expected to contain greater than 15 percent of any one contaminant.
- B. “Hazardous Samples” include soil or water samples that may be highly contaminated; product, sludge, or waste pile samples of concentrated wastes; and any sample from a closed drum or container.

2.2 SAMPLE STORAGE

- A. Samples should be stored in a manner consistent with the requirement for sample preservation to maintain the quality of the sample. Samples preserved by cooling should be stored in such a way as to maintain the acceptable range of temperature for the duration of the holding time.
- B. Samples should not be stored onsite for extended periods and should be protected from environmental extremes. Shipment to the laboratory should be completed as soon as possible and well within the specified

holding times for each particular analysis (refer to the QAPP) to allow analysis within the holding time limits.

- C. If temporary storage is necessary, samples should remain in an area that has been designated as the "sample storage area," which must be locked and secured to maintain sample integrity and chain-of-custody requirements. Separate containers must be used to store or transport low, medium, and high concentration samples.
- D. Samples shall not be stored in refrigerators or other areas where food or drink may also be stored, and vice versa.

2.3 ENVIRONMENTAL SAMPLE PACKAGING

2.3.1 Regulatory Considerations

- A. DOT regulations do not consider environmental samples hazardous. In addition, DOT has stated that dilute solutions of chemical preservatives are not subject to Hazardous Materials Regulations as long as the concentrations do not exceed specified values listed in Table 911-1.

- B. In accordance with 49 CFR 173.24(a), the following is required for all packages:

"Each package used for shipping hazardous materials . . . shall be so designed and constructed, and its contents so limited, that under conditions normally incident to transportation:

- (1) there will be no significant release of the hazardous materials to the environment;
- (2) the effectiveness of the packaging will not be substantially reduced; and
- (3) there will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, or through an explosion, significantly reduce the effectiveness of the packaging."

- C. In accordance with 94 CFR 173.6(a), the following is required for all shipment by air:

"Each package . . . shall be so designed and constructed, and its contents so limited, that under conditions normally incident to transportation;

- (1) there will be no significant release of . . . materials to the environment.
- (2) Inner containers that are breakable (such as earthenware, glass, or brittle plastic) must be packaged to prevent breakage and leakage under conditions normally incident to transportation. Those completed packagings must be capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. Cushioning and absorbent materials must not react dangerously with the contents . . .
- (3) For any packaging with a capacity of 110 gallons or less containing liquids, sufficient outage (ullage) must be provided to prevent liquid contents from completely filling the packaging at 130° F. The primary packaging (which may include composite packaging), for which retention of the liquid is the basic function, must be capable of withstanding, without leakage, an internal absolute pressure of not less than 26 pounds per square inch or no less than the sum of the absolute vapor pressure of the contents at 130° F (55° C) and the atmospheric pressure at sea level, whichever is greater.
- (4) Stoppers, corks, or other such friction-type closures must be held securely, tightly, and effectively in place with wire, tape, or other positive means. Each screw-type closure on any inside plastic packaging must be secured to prevent the closure from loosening due to vibration or substantial changes in temperature . . .”

2.3.2 Shipping Containers

- A. All sample containers should be placed inside a strong shipping container capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. A metal or plastic picnic cooler (ice chest) with a hard plastic liner withstands this test. The drainage hole at the bottom of the cooler must be taped shut so that the contents from the broken containers or water from ice bags will not escape. The shipping container should be taped shut to form an adequate seal around the lid to prevent any leakage in the event that the cooler is turned over.
- B. The shipping container should be marked “THIS END UP” with arrows indicating the proper upward position of the container affixed to all four sides. To prevent cross-contamination, the shipping container must be adequately cleaned between shipments.

2.3.3 Ice

Ice should be placed into 1-gallon size plastic bags (minimum 2-mil thick) and sealed tightly. The amount of ice used will depend on the available space in the cooler, but 10 pounds per 20 quarts of cooler volume would be the minimum to assure sufficient cooling. Dry ice (CO₂) generally should not be used.

2.3.4 Glass Containers

The lid of the container should be tightened to assure an adequate seal. The container may be placed into a clear plastic bag that has a minimum thickness of 2-mil (many 1-quart and 1-gallon size zip-lock bags are suitable) and this bag sealed. They should be wrapped and cushioned in an inert packing material such as bubble wrap or shredded paper.

2.3.5 Plastic Containers

Plastic containers do not require individual cushioning material, but should be packed to prevent movement during transport. Caps should be tightly screwed on. These bottles may also be placed into a 2-mil thick plastic bag and the bag sealed.

2.4 HAZARDOUS SAMPLE PACKAGING

2.4.1 Regulatory Considerations

- A. Hazardous samples are classified as ORM-E (Other Regulated Material - Series E) substances by the DOT. They are treated as a flammable liquid or solid and must be packaged accordingly to conform to DOT requirements.
- B. If a sample is known to contain a material identified in the DOT Hazardous Materials Table (49 CFR 172.101), packaging and shipment should conform to the specific requirements for that substance.
- C. If the nature of the sample is unknown, the materials should be prepared for shipment in accordance with DOT regulations for packaging and labeling the ORM-E hazard class.

2.4.2 Shipping Containers for Unanalyzed Waste Excluding Closed Container Samples

- A. The procedures in this section should be applied to unanalyzed waste samples except those that come from closed containers whose contents are presumed to warrant a more careful packaging as described in Section 2.4.3.
- B. Each sample container, properly labeled with sample information, should be placed into a 4-mil minimum thickness polyethylene bag (one sample per bag) and the bag sealed tightly with tape. This sealed container is placed into a metal can or overpack (such as a 1-gallon paint can) with incombustible, absorbent cushioning material, such as bubble wrap. Only one bag should be placed inside each can. The can lid should be closed tightly and sealed using tape or clips.
- C. Each metal can must bear the following labels and markings:
 - 1. Testing laboratory name and address and a return address.
 - 2. "Flammable Liquid, N.O.S." marking. The abbreviation "N.O.S." means "Not Otherwise Specified."
 - 3. "This End Up" arrows.
- D. The following labels must be placed next to one another and near the "Flammable Liquid, N.O.S." marking:
 - 1. "Cargo Aircraft Only"
 - 2. "Flammable Liquid" or "Flammable Solid" and "Dangerous When Wet"
- E. More than one can may be placed in a shipping container surrounded with incombustible packaging material for stability. The outside of the shipping container must bear the following markings and labels:
 - 1. All of the labels described above for the sample cans; and
 - 2. "Laboratory Samples," and
 - 3. "This End Up" on the container top with upward pointing arrows on all four sides.

- F. Using the word “flammable” does not convey the certain knowledge that a sample is, in fact, flammable or how flammable, but is intended to prescribe the class of packaging in order to comply with DOT regulations.

2.4.3 Shipping Containers for Unanalyzed Waste from Closed Containers

- A. The Project Manager should make a judgment as to the hazard class of all samples from closed containers based upon available data. The following procedures provide typical worst-case methods for packaging materials classed by the DOT as “Poison A”; this type of “reasonable doubt” practice is provided for in the regulation (49 CFR 172.402 h).
- B. Unless reliable data exclude the possibility of the presence of “Poison A” substances (as defined in 49 CFR 163.326), sample containers of unanalyzed waste from tanks or drums (solid, liquid or gas) must be packaged in a DOT Spec. 3A1800 or 3AA1800 metal compressed gas cylinder.
- C. The sample container is first labeled with required sample information. Then, using a string of flexible wire attached to the neck of the sample container, it is lowered into a metal cylinder partially filled with incombustible, absorbent, packaging material. Allow enough cushioning material between the bottom and sides of the sample container and metal cylinder to prevent breakage. After the sample container is completely covered with cushioning material, the string or wire is dropped into the cylinder. The cylinder valve assembly and protector are replaced.
- D. The following markings must be placed on the tag wired to the cylinder valve protector or a label affixed to the cylinder itself:
1. “Poisonous Liquid, N.O.S.”
 2. Laboratory name and address and return address
- E. The following label must be placed on the cylinder, regardless of the location of all other markings:
- “Poisonous Gas” (the “Poisonous Liquid” label is not acceptable here, even if the sample is a liquid).
- F. One or more cylinders may be placed into the same shipping container. The shipping container must bear the following markings:
1. All of the labels described above for the metal cylinders, and

2. "Laboratory Sample" and "Inside Packages Comply with Prescribed Specifications" should be marked on top of the container.
3. "This Side Up" marking should be placed on the top of the container with upward pointing arrows on all four sides.

2.5 SHIPPING OF SAMPLES

2.5.1 Environmental Samples

Environmental samples may be shipped to the testing laboratory by commercial common carrier, bus, rental vehicle, or air cargo service. Samples should be received by the laboratory within 24 hours after sampling or sooner, if necessary, to allow initiation of analyses within prescribed holding times.

2.5.2 Hazardous Samples

- A. Hazardous samples, excluding those from closed containers, may be shipped by common carrier, air cargo, or other more protective means suitable for closed container shipments as described below.
- B. Carrier-provided bills of lading and certification for restricted articles will be completed and signed. Standard industry forms will be used if carrier does not provide them. One form may be used for multiple shipping containers. The following information should be entered on the shipping papers:
 1. "Flammable Liquid (or Solid), N.O.S."
 2. "Net Weight" by item or "Net Volume" by item
 3. "Cargo Aircraft Only"
 4. "Limited Quantity"
 5. "Laboratory Samples"
- C. Shipping containers with unanalyzed wastes from drums or tanks should be entered as "Poisonous Liquid, N.O.S." on the first line above.
- D. Unanalyzed samples taken from closed containers may not be transported by commercial air cargo or common carrier aircraft or by rental, non-government aircraft. Federal regulations require shipment by common, public, or commercial "ground" carrier, or governmental aircraft.

TABLES

TABLE 911-1
Standard Preservative Solutions
Exempted from DOT Hazardous Waste Regulation *

Preservative	Quantity of Preservative per Liter of Sample	Maximum Weight of Preservative (%)
HCl	2 ml of 1:1 **	0.04
H ₉ Cl ₂	40 mg	0.004
HNO ₃	3 ml of 1:1	0.15
H ₂ SO ₄	2 ml of 36 N	0.35
NaOH	2 ml of 10 N	0.08
H ₃ PO ₄	Sufficient to yield pH range between 2 and 4	

NOTES:

* USEPA, NEIC, "Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors," Draft, dated April 1980; Appendix D: Letter of Understanding Provided EPA by DOT for Environmental Samples.

** Ratios are volume of acid to distilled water.

Standard Operating Procedure No. 912

SAMPLE CONTROL AND CUSTODY PROCEDURES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 912 describes the guidelines for controlling sample identification and chain of custody in order to maintain the quality and integrity of samples during collection, transportation, and storage for analysis as described in the Work Plan or as otherwise specified.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Sample control and custody shall be followed, without exception, by all persons involved in sampling and documentation activities as specified in the Work Plan and/or QAPP.
- B. Samples may be defined as any physical evidence collected for environmental measuring and monitoring.
- C. Sample identification documentation must be prepared to maintain sample identification and chain of custody. The following are examples of sample identification documentation:
 - 1. Sample identification labels
 - 2. Chain of custody records
 - 3. Custody seals (if required in QAPP)
 - 4. Field logbook

The above documentation items are discussed in the QAPP. Other documentation items including sample traffic reports, receipts for sample forms, analytical request forms, and shipment records may also be required for CLP laboratories.

2.2 SAMPLE IDENTIFICATION LABELS

2.2.1 Label Forms

- A. Sample labels shall be provided to the sample personnel by the site manager in a form appropriate for the sampling activity. Labels may be

pre-printed with spaces for the appropriate sample identification and information requirements, or may be blank with lines provided for uniform recording. The label shall be of the type material that ink will write, but not be so overly absorbent that ink will run. Labels should be self-adhesive on glass and polyethylene containers. An example of a sample label is shown in Figure 912-1.

- B. The following sample information should be entered on each sample label and tabulated in the field logbook.
1. Project identification number or code.
 2. Date and time of the sample collection.
 3. Sample station identification (boring number, well number, etc.).
 4. Sample identification number or code that uniquely identifies the sample's location (including area location and depth), whether it is a replicate or blank (see exception below**).
 5. Preservative(s) used.
 6. Analysis code, indicating which general group of analyses is intended for that particular container of sample.
 7. Serial number (if required).
 8. Comments or notations to inform the laboratory of any special circumstances or warnings. Also, indicate if sample is a "grab" or "composite" sample.
 9. Internal temperature of shipping container when sample(s) is (are) placed in container.
 10. Sampling personnel initials.

** Exception: If the quality assurance samples (replicates, blanks, etc.) are to be kept anonymous to the laboratory, then all samples should be identified by a code or numeric system that does not reference the sample as such.

2.2.2 Labeling Procedure

- A. Following collection of the sample and placement into the appropriate container, wipe excess soil, waste, or water from the container. Affix adhesive label or tag to container.
- B. Complete label information as prescribed above, using indelible ink. If a mistake is made, neatly mark through the mistake and write in the correction, initialing the correction. If the label is too smudged or damaged to neatly correct, void it by writing "VOID" across it and initial it, then affix a new label onto the container, partially covering the voided label.
- C. Cover the label with clear plastic adhesive tape to protect the label and prevent it from being subsequently written upon.
- D. Serialized sample labels, if used, require additional procedures and restrictions not provided in this SOP.
- E. For custody control, a sample label should be considered to be in an individual's possession until it is filled out, attached to the sample, and transferred to another individual along with the corresponding chain of custody form.

2.3 CHAIN OF CUSTODY RECORD

2.3.1 Definition of Custody

- A. A sample is under custody if one or more of the following criteria are met:
 - 1. The sample is in sampler's possession.
 - 2. It is in the sampler's view after being in possession.
 - 3. It was in the sampler's possession and then was locked up to prevent tampering.
 - 4. It is in a designated secure area.
- B. Because samples collected during an investigation could be used as evidence in litigation, possession of the samples must be traceable from the time each sample is collected until the sample is introduced as evidence in legal proceedings. To document sample possession, chain of custody procedures and documentation are discussed below.

2.3.2 Chain of Custody Documentation and Forms

- A. Chain of custody documents are initiated by the sampling personnel in the field with the notation of sampling data and sample identification during the sampling activity. Generally, these data are collected in the field logbook in a tabulated form along with the description of the sample and sampling procedure and includes the following:
1. Project number
 2. Sample station identification
 3. Sample identification
 4. Date and time sample was taken
 5. Sample type
 6. Number and type of container used
 7. Whether sample was grab or composite
 8. Preservation method used
 9. Analysis requested
 10. Name of sampling personnel involved
- B. Each sample sent offsite would be recorded on a chain of custody form by the sampler or a field sample custodian at the site. The form should be filled out after returning the sample from the sampling locations and after decontamination. An example chain of custody form is provided in Figures 912-2 for First Environmental Laboratories of this SOP.
- C. The chain of custody form should be completed by the sampler or by the field sample custodian on behalf of the sampler. The information indicated on the chain of custody form should be reconciled with that in the field logbook used by the sampler personnel. The chain of custody form should be signed by the sampling personnel.

2.3.3 Custody Seals

- A. When samples are shipped to the laboratory, they must be placed in containers sealed with tape, with custody seals affixed to the storage containers. Some custody seals are serially numbered. These numbers must appear in a cross-reference matrix of the field document and on the chain of custody report. Other types of custody seals include unnumbered seals and evidence tape. An example of a custody seal is shown in Figure 912-3.
- B. When samples are shipped, two or more seals are to be placed on each shipping container (such as a cooler), with at least one at the back, located in a manner that would indicate if the container were opened in transit. Wide, clear tape should be placed over the seals to ensure that

seals are not accidentally broken during shipment. Nylon packing tape may be used providing that it does not completely cover the custody seal. Completely covering the seal with this type of tape may allow the label to be peeled off. Alternatively, evidence tape may be substituted for custody seals.

- C. If samples are subject to interim storage before shipment, custody seals or evidence tape may be placed over the lid of the jar or across the opening of the storage box. Custody during shipment should be the same as described above. Evidence tape may also be used to seal the plastic bags or metal cans used to contain samples in the cooler or shipping container. Sealing individual sample containers assures that sample integrity will not be compromised if the outer container seals are accidentally broken.

2.3.4 Field Custody Procedures

- A. Only enough of the sample should be collected to provide a good representation of the medium being sampled. To the extent possible, the quantity and types of samples and the sample locations should be determined before the actual fieldwork. As few people as possible should handle the samples.
- B. Field samplers are personally responsible for the care and custody of the samples collected by their teams until the samples are transferred or dispatched properly. A person should be designated to receive the samples from the field samplers after decontamination; this person maintains custody until the samples are dispatched.
- C. The site manager should determine whether proper custody procedures were followed during the fieldwork and should decide if additional samples are required to make up for any deficiencies.
- D. Samples shall be accompanied by the designated chain of custody form or record for the laboratory receiving the samples. When transferring samples, the individuals relinquishing and receiving them should sign, date, and note the time on the form. This form documents sample custody transfer from the sampler, often through another person, to the analyst at the laboratory.
- E. Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain of custody record accompanying each shipment. Shipping containers are sealed with tape, and custody seals are affixed to the storage containers for

shipment to the laboratory. The method for shipment, courier name(s), and other pertinent information such as the laboratory name and contact should be entered in the "Remarks" section of the chain of custody record.

- F. When samples are split with an owner, operator, or government agency, the event is noted in the "Remarks" section of the chain of custody record. The note indicates with whom the samples are being split. The person relinquishing the samples to the facility or agency requests the signature of the receiving party on a receipt-for-samples form, thereby acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this situation is noted in the "Remarks" section of the chain of custody record. The samples shall be secured if no one is present to receive them.
- G. All shipments are accompanied by a record identifying their contents. The original form accompanies the shipment; the copies are retained by the sampler.
- H. If nonhazardous samples are sent by mail, the package is registered, and the return receipt is requested. (NOTE: Hazardous materials shall not be sent by mail.) If samples are sent by common carrier, a bill of lading is used. Airfreight shipments should be sent prepaid. Freight bills, postal service receipts, and bills of lading should be retained as part of the permanent documentation of the chain of custody records.

2.4 FIELD LOGBOOK

- A. A bound field logbook must be maintained by the sampling team leader to provide daily records of significant events, observations, and measurements during field investigations as specified in SOP No. 110. All entries are to be signed and dated. Observations or measurements taken in an area where contamination of the field notebooks may occur may be recorded in separate bound and numbered logbooks before being transferred to the project logbook. The original records are retained, and the delayed entry is noted as such.
- B. Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during projects and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. The field notebook entries should be factual, detailed, and objective.

2.4.1 Corrections to Documentation

- A. Unless restricted by weather conditions, all original data recorded in field logbooks and on sample identification labels, chain of custody forms, and custody seals forms are written in waterproof ink. Accountable serialized documents are not to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.
- B. If an error is made on an accountable document assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on an accountable document should be corrected by the person who made the entry. All corrections must be initialed and dated.
- C. For all photographs taken, a photographic log should be kept; the log records date, time, subject, frame, roll number, and photographer. The photographer should review the photographs or slides when they return from developing and compare them to the log to ensure that the log and photographs match.

FIGURES

FIGURE 912-1

SAMPLE LABEL

Clayton Group Services, Inc.
3140 Finley Road, Downers Grove, IL 60515
Lockformer / Lisle, IL
Project No. 15-65263.01

Sample: _____

Analysis: _____

Preservative: _____

Date: ____/____/____ Time: ____:____ By: ____

FIGURE 912-2

CHAIN OF CUSTODY RECORD

First Environmental Laboratories



Page ____ of ____ pgs

IEPA Certification# 100292

Sampled By:

Analyses

P.O. #.:

Matrix Codes: S = Soil W = Water O = Other

[illegible]

Received within 6 hrs. of collection: _____

Notes and Special Instructions:

Date/Time

Date/Time

FIGURE 912-3

CUSTODY SEAL

Clayton
LABORATORY
SERVICES

CUSTODY SEAL

date

signature

Standard Operating Procedure No. 920

FIELD QUALITY ASSURANCE SAMPLES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 920 describes the guidelines and typical frequencies for preparing and submitting quality assurance (QA) samples for chemical analyses along with site media to support the validity of chemical data generated for the sampling event as described in the Work Plan or otherwise specified.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS AND CONSIDERATIONS

- A. QA samples should be included within each separate sampling event as a means of evaluating the validity of chemical data. The use of QA samples should provide sufficient evidence to conclude that media samples are representative of the in situ state of the media and that chemicals found within them are not overtly affected by chemicals from outside sources or cross-contamination.
- B. Field QA samples may include one or more of the following types:
 - 1. Replicates (Duplicates)
 - 2. Equipment Blanks
 - 3. Field Blanks
 - 4. Trip Blanks
- C. Media for QA sampling should be of similar physical condition as the site media being sampled (i.e., soil, liquid, vapor), so that the QA sample is likely to be contaminated the same way and by the same degree as would the site media being sampled.
- D. All QA samples may be submitted to the laboratory “blind,” when possible, in cases where data results and validity are critical. Accordingly, sample identification should be used that does not designate the QA samples as being different from the actual site media samples collected.

This is generally not to be performed unless specifically stated in the Work Plan.

2.2 REPLICATE SAMPLES

2.2.1 Replicate Purpose Types

- A. Replicate samples provide duplicate or additional specimens or aliquot from the same sample by dividing the original sample at some point in the measurement process. Field replicates are split in the field for potential repeat testing of essentially the same sample at a given laboratory, or they may be split and tested at different laboratories.
- B. Replicates may be discrete or composite; however, each replicate must be prepared the same way. Replicates from discrete samples must come from the same sample; that is, they must be divided from a portion of the sample taken from the same interval at the same time. For example, discrete replicates would be
 - 1. For solid sample media, the replicates could be divided from the same sampler device at a particular depth taken at the same location and time.
 - 2. For groundwater, the replicates would be divided from the contents of the same bailer full of water. Replicates from composite samples should be taken only after these samples have been thoroughly blended to insure uniformity.

2.2.2 Replicate Preparation and Sampling

- A. Replicate (duplicate) soil samples or other solid matrices for volatile and semi-volatile organic compounds (VOCs and SVOCs) obtained with discrete samplers should be prepared as follows:
 - 1. Select the vertical interval of the cylindrical soil core to be replicated.
 - 2. Split the section in half along the length of the core, then split each half in half along its length into quarters.
 - 3. Combine diametrically opposite quarters from the core sections to create two duplicate samples.

- B. Replicate (duplicate) soil samples or other solid matrices for other compounds (Metals, PCBs, etc.) obtained with discrete samplers should be prepared as follows:
1. Put the soil core into a clean stainless steel mixing bowl and homogenize the media by mixing with a decontaminated implement until its appearance is consistent.
 2. The samples should then be collected alternately filling the investigative and duplicate sample containers from the homogenized sample media.
- C. Typically, a composite replicate from each coring or sampling interval will be required to obtain the necessary volume of soil material to fill each sample aliquot for required analysis. In this case, select additional vertical core sections along the entire length of the core as is both available and representative, then repeat the process described in A above. For instance, if the available total core length from a particular sampling interval is 18 inches long, perhaps select the top and bottom 6-inch-long section to replicate. The remaining middle section could be used for additional chemical analysis, discrete replication, or for geotechnical testing. In this example, equivalent proportions from both the top and bottom sections would be included in each sample aliquot.
- D. For aqueous matrices, the replicates should be prepared as follows:
1. Obtain aqueous sample from well, surface body, or container, and pour contents of the sampler into a single collection container. For samples to be analyzed for volatile organic compounds (VOCs), alternate filling vials for regular and replicate samples from the sampling device to prevent agitation.
 2. If one sampler volume is not adequate for all required specimens and replicates, then a composite of more than one sampler volume should be made.
 3. The collection container should have only limited air space available to limit volatilization during blending. The agitation while decanting the sample into the collection container should be adequate to mix the sample from one or more samplers.
 4. Decant equivalent amounts from the collection container into appropriate jars to create replicates.

- E. Replicates may be spiked in the laboratory to determine the extent of matrix bias or interference on analyte recovery and sample-to-sample precision.
- F. The frequency required for obtaining replicates of site media samples may be conducted, as specified. Generally, duplicates should be taken at least once per analytical batch or once per 10 samples per matrix, whichever is more frequent.

2.3 EQUIPMENT BLANKS

2.3.1 Equipment Blank Purpose

- A. Equipment or rinsate blanks are artificially prepared matrix-similar samples used to evaluate whether field equipment has been adequately decontaminated so as not to yield a false-positive concentration of contaminants.
- B. Positive results from blanks should not be used to correct results from site media samples, but rather to identify a problem and warrant action to correct the source of cross-contamination.

2.3.2 Aqueous Equipment Blank Preparation and Sampling

- A. For aqueous equipment blanks, two methods are available as follows:
 - 1. Prepared container
 - 2. Rinsate sample

For the prepared container equipment blank, a pint jar is filled to near-full with deionized water. For the rinsate sample, deionized water over equipment components that were exposed to the sample, then collected in a sample jar.

- B. Transport prepared container of aqueous equipment blank to field in sample shuttle. Stir small sampling tools and probes of field instruments that come into direct contact with site media in the water in the container. Handle and preserve blank as for the media being sampled.
- C. For rinsate samples, hold samplers and tools over a cleaned sample container. Using a squirt bottle, rinse the equipment with distilled water sufficiently to collect sample quantity for the analysis. For larger specimen quantity requirements, pour additional distilled water from a

supply container over the equipment into a collection container, then decant into the appropriate sample containers. Equipment or rinsate samples should be handled and preserved similar to the site media samples.

2.4 FIELD BLANKS

2.4.1 Field Blank Purpose and Preparation

- A. Field blanks are matrix-similar samples, artificially prepared, used to evaluate background or ambient conditions and handling procedures that may affect the results of site media samples.
- B. Positive results from field blanks should not be used to correct results from site media samples, but rather should be used to identify potential sources of false positive results due to ambient conditions or handling procedures in the field.
- C. Field blanks should be prepared identically as for equipment blanks previously described, except that no rinsate samples would be prepared.

2.4.2 Field Blank Sampling

- A. Field blanks should be sampled by opening the sample container of material during the entire time that a site medium sample is exposed to ambient conditions.
- B. The field blank should remain open in the general area of the sample handling activity, but in such a place that it is not subject to airborne or other undesirable contamination to which a site-medium sample would not also be subject.
- C. Close the field blank container at the completion of the sampling interval activity and handle and preserve as for any other site medium.

2.5 TRIP BLANKS

2.5.1 Trip Blank Purpose and Preparation

- A. Trip blanks are media-similar shapes, prepared in the analytical laboratory, shipped with the cleaned sample containers (usually provided by the laboratory), carried through the field sampling activity, and returned to the laboratory, having never been opened.

- B. Trip blanks should be used by the laboratory to evaluate whether (1) the laboratory is contributing cross-contamination to tested samples either via the sample containers it provides or via laboratory contaminants during the testing or (2) contaminants are falsely introduced into site-media during handling at the laboratory or during shipping due to contaminants being on the outside of the sample container.
- C. Positive results should not be used to correct results of analysis on site media samples, but rather should be used to identify sources of false positive results due to inadequate procedures and to enact corrective action.
- D. Trip blanks should ideally be prepared using materials similar to the site media; however, typically deionized water or water identified as Type II reagent grade will be used.

2.5.2 Trip Blank Sampling

- A. Place trip blank into field sample shuttle (cooler) along with sample containers for site media. Sample shuttle should remain shut except to take out or place in a sample container from that time until it is returned to the site sample dispensing area.
- B. At a selected sampling interval or location, take out the trip blank along with sample containers for the sampling interval or location. Do not open the trip blank container.
- C. Sample site media as per the Work Plan. Label and handle the trip blank as for any other sample at that location.

Standard Operating Procedure No. 930

CONTROL, CALIBRATION AND MAINTENANCE OF MEASUREMENT AND TEST EQUIPMENT

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 930 describes the guidelines for controls, calibration, and maintenance of measurement and test equipment to be used for obtaining samples for chemical analyses for measuring field parameters, and for testing various parameter/characteristics. The purpose of this SOP is to ensure the validity of field measurement data generated during field activities as required in the Work Plan or as otherwise specified.

2.0 EXECUTION

2.1 GENERAL REQUIREMENTS

- A. Measuring devices must be calibrated before initial use and re-calibrated once daily at a minimum or as recommended in the manufacturer's instructions. Daily calibrations will be recorded on the daily field notes or logbook.
- B. Instrument operators must be thoroughly familiar with the operation of measuring instruments. Users should complete the appropriate training and be certified, if required, before using the instrument in the field.
- C. Manufacturer's instructions should be followed for correct methods of operation for various measuring devices.
- D. All equipment/instrumentation will be uniquely and permanently identified (model/serial number, equipment inventory number, etc.). Maintenance / calibration instructions and permanent individual record books will be provided with each instrument or equipment. Manufacturers' recommended maintenance/calibration records will be kept with the equipment/instrument record book(s). (Note: Actual location of these maintenance/calibration records may vary; however, location must be stipulated by vendor, subcontractor, etc., before work. Records must also be available to Clayton staff upon request.)

- E. If the calibration/maintenance frequency differs from that recommended by the manufacturer or applicable codes/specifications, the applicable code/specification frequency shall apply (or both may be used). The frequency or calibration may be shortened if equipment is subject to severe conditions or there is reason to believe the equipment is not functioning properly.
- F. Equipment logs shall record the date equipment is entered to the project and withdrawn from the project.
- G. The site manager will obtain, identify, and control all equipment/instruments to be used during the projects. Subcontractors will coordinate their equipment items/uses with the site manager in accordance with this SOP.

2.2 Photovac 2020 PID

2.2.1 Startup/Shutdown Procedures

- A. Startup procedures for the Photovac 2020 are as follows:
 - 1. Turn the unit on by pressing the on/off button. Let the PID run for approximately 5-10 minutes before calibrating. If “Lbat” appears on the LCD screen, the battery must be charged before using.
 - 2. Check instrument with an organic point source, such as “magic marker,” before survey to verify instrument function.
- B. Shutdown procedures for the HNU are listed below:
 - 1. Turn the PID off by pressing and holding the on/off button for a few seconds.
 - 2. Plug the instrument charger into the unit and the wall while recharging the battery.

2.2.2 Maintenance and Calibration Schedule

- A. The following maintenance and calibration schedule represents the minimum requirements for operation of the Photovac tool.

Function	Frequency
Perform routine calibration	Prior to each use; at least once daily
Initiate factory checkout and calibration	Yearly or when malfunctioning or after changing UV light source
Wipe down readout unit	After each use
Replace Teflon filter	Every month or as use and site conditions dictate
Recharge battery	After each use

B. Instruments should be thoroughly checked before their first use.

2.2.3 Calibration Procedures (with Regulator)

The calibration of the analyzer can be rapidly checked by the use of a standard calibration gas cylinder containing isobutylene with a regulator. After calibration in the factory, the Photovac 2020 can be re-calibrated in the field as follows:

1. Make sure the sample probe is connected to the 2020 inlet. Ensure that the sample probe is free of any contamination, as this will effect the calibration. Press the ENTER key. Select "Set," "Cal," and then "Mem."
2. Select "Chng" and then "User." Enter a name for the calibration memory. Press the ENTER key and enter a response factor (RF). The RF for isobutylene gas is 1.0. The concentration detected by the 2020 will be multiplied by the RF before it is displayed and logged.
3. Press the ENTER key and enter an alarm level for STEL, TWA, and PEAK.
4. Press ENTER and expose the 2020 to a supply of zero air.
5. Select "Set," "Cal," and "Zero." Allow the 2020 to set its zero point.
6. Select "Set," "Cal," and "Span." The 2020 asks for the span gas concentration (usually on bottle). Enter the known span gas concentration, hook up the gas cylinder, open the regulator, and press ENTER.
7. When the display reverts to the default display, the 2020 is calibrated and ready for use.
8. Remove the adapter tubing from the inlet and close the regulator.

Isobutylene is nontoxic and safe to use in confined areas. There are no listed exposure levels at any concentration. The regulator sets and controls the flow rate of gas at a value preset at the factory. Do not use the cylinder below about 30 psi as readings below that level can deviate up to 10% from the rated value.

Table 930-1 provides photoionization sensitivity values for various chemicals ionized by 10.6 eV lamps.

2.3 ORGANIC VAPOR ANALYZER (OVA)

2.3.1 Startup/Shutdown Procedures

A. Startup procedures for the OVA are as follows:

1. Connect the probe/readout connectors to the side-pack assembly.
2. Check battery condition by moving the pump switch to ON and moving the instrument switch to the battery position. The needle should deflect past the white line in the probe.
3. For measurements taken as methane equivalent, check that the GAS SELECT dial is set at 300.
4. Turn the electronics on by moving the INST switch to the ON position, and allow 5 minutes for warm-up.
5. Set CALIBRATE switch to X10; use CALIBRATE knob to set indicator at zero.
6. Open the H₂ tank valve all the way and the H₂ supply valve all the way. Check that the hydrogen supply gauge reads between 8.0 and 12.0 psi. (About 150 psi of H₂ is required per each hour of survey operation.)
7. Turn the PUMP switch ON, and check the flow system according to the procedures in Subsection 2.3.2.
8. Check that the BACKFLUSH and INJECT valves are in the UP position.
9. To light the flame, depress the igniter switch until a meter deflection is observed. The igniter switch may be depressed for up to 5 seconds. Do not depress for longer than 5 seconds, as it may burn out the igniter coil. If the instrument does not light, allow the instrument to run several minutes and repeat ignition attempt.

10. Confirm OVA operational state by using an organic source, such as a "magic marker."
11. Establish a background level in a clean area or by using the charcoal scrubber attachment to the probe (depress the sample inject valve) and by recording measurements referenced to background.
12. Set the alarm level, if desired, by turning the calibrate volume knob fully clockwise.

B. Shutdown procedures for the OVA are as follows:

1. Close H₂ supply valve and H₂ tank valve (do not over tighten valves).
2. Turn INST switch to OFF.
3. Wait until H₂ supply gauge indicates system is purged of H₂; then switch off pump (approximately 10 seconds).
4. Put instrument on electrical charger at completion of day's activities.

2.3.2 Pump System Checkout Procedure

The procedure to ensure that the pump system is in proper working order is as follows:

1. With the pump on, hold unit upright and observe flow gauge.
2. See if ball level is significantly below a reading of 2; if so, flow is inadequate.
3. Check connections at the sample hose.
4. Clean or replace particle filters if flow is impaired or if it is time for scheduled service.
5. Reassemble and retest flow.
6. If flow is still inadequate, replace pump diaphragm and flow valves.
7. If flow is normal, plug air intake. Pump should slow and stop.
8. If there is no noticeable change in pump, tighten fittings and retest.

9. If there is still no change, replace pump diaphragm and valves.
10. Document this function in the field logbook and the maintenance logbook.

2.3.3 Maintenance and Calibration Schedule

The maintenance and calibration schedule listed below should be followed. Instruments should be thoroughly checked before their first use.

Function	Frequency
Check particle filters	Weekly or as needed
Check quad rings	Monthly or as needed
Clean burner chamber	Monthly or as needed
Check secondary calibration	Prior to project startup; daily
Check primary calibration	Monthly or if secondary check is off by more than ± 10 percent
Check pumping system	Before project startup
Replace charcoal in scrubber attachment	120 hours of use or when background readings are higher with the inject valve down than with the inject valve up in a clean environment
Factory service	At least annually

2.3.4 Calibration Procedure

- A. Primary calibration procedures for operation of the OVA are listed below:
1. Remove instrument components from the instrument shell.
 2. Turn on ELECTRONICS and ZERO INSTRUMENT on X10 scale. Turn GAS SELECT dial to 300.
 3. Turn on PUMP and HYDROGEN. Ignite flame. Go to SURVEY MODE.
 4. Introduce a methane standard near 100 parts per million (ppm).
 5. Adjust R-32 Trimpot on circuit board to make meter read to standard.

6. Turn off hydrogen flame and adjust meter needle to read 40 ppm (calibrate @ X10) using the calibration adjust knob.
7. Switch to X100 scale. The meter should indicate 0.4 on the 1-10 meter markings ($0.4 \times 100 = 40$ ppm). If the reading is off, adjust with R33 Trimpot.
8. Return to X10 scale and adjust meter needle to 40 ppm with calibration; adjust knob, if necessary.
9. At the X10 scale, adjust meter to read 0.4 on the 1-10 meter markings using the calibration adjust. Switch to X1 scale. The meter should read 4 ppm. If the reading is off, adjust using R31 Trimpot.

B. Secondary calibration procedures are listed below:

1. Fill an air sampling bag with 100 ppm (certified) methane calibration gas.
2. Connect the outlet of the air-sampling bag to the air-sampling line of the OVA.
3. Record the reading obtained from the meter on the calibration record.

2.4 COMBUSTIBLE GAS INDICATOR (MODEL MSA 361)

2.4.1 Operation/Calibration Procedures

Before calibration of the combustible gas indicator (CGI) Model MSA 361 can be checked, the instrument must be in operating condition.

Operating Instructions

- A. Turn the FUNCTION control to the HORN OFF position; the HORN OFF indicator will light, and the descriptor % LEL will show in the readout.
- B. Set the readout to zero by adjusting the LEL ZERO control. (NOTE: this must be done within 30 seconds of turning ON to prevent the possibility of activating the off-scale LEL latching alarm).
- C. Press the SELECT button firmly to obtain % OXY on the readout; then set the readout to 20.8% by adjusting the OXY CALIBRATION control.

- D. Press the SELECT button firmly to obtain PPM TOX on the readout; then set the readout to zero by adjusting the TOX ZERO control.
- E. Press the RESET button.
- F. Turn the FUNCTION control to MANUAL for continuous readout of any one gas, or to SCAN for automatic scanning of the three gas readings.
- G. Momentarily place a finger over the sample inlet fitting or the end of the sample line, if one is used. Observe that the FLOW indicator float drops, indicating no flow. If it does not, check the flow system and sample line for leaks.
- H. The instrument is ready for sampling. Move it to the area for sampling, or place the end of the sampling line at the point the sample is to be taken.

Calibration

- I. Calibration of the CGI Model MSA 361 will be performed once each working day. If there is a reason to suspect that the instrument is producing incorrect readings, the instrument will be calibrated more frequently during the day. The following calibration procedure should be followed:
 - 1. Attach the flow control to the 75% pentane/15% oxygen calibration gas tank.
 - 2. Connect the adapter-hose fitting to the flow control.
 - 3. Open the flow control valve.
 - 4. Connect the adapter-hose fitting to the inlet of the instrument; within 30 seconds, the LEL meter should stabilize and indicate between 47 and 55%. If the indication is not in the correct range, remove the right end of the indicator and adjust the LEL SPAN control to obtain 50%.
 - 5. Verify the oxygen reading; it should be between 13 and 17%.
 - 6. Disconnect the adapter-hose fitting from the instrument.
 - 7. Close the flow control valve.

8. Remove the flow control from the calibration gas tank.
 9. Attach the flow control to the 10 ppm hydrogen sulfide calibration gas tank. (40 ppm gas may be used; the choice of H₂S calibration gas will depend upon concentrations anticipated in the work place.)
 10. Open the flow control valve.
 11. Connect the adapter-hose fitting to the inlet of the instrument; after approximately 1 minute, the TOX readout should stabilize and indicate between 7 to 13 ppm (35 to 45 ppm for 40 ppm H₂S). If the indication is not in the correct range, remove the right end of the indicator and adjust the TOX SPAN control to obtain 10 ppm (40 ppm for 40 ppm H₂S).
 12. Disconnect the adapter-hose fitting from the instrument.
 13. Close the flow control valve.
 14. Remove the adapter-hose fitting from the flow control.
 15. Remove the flow control from the calibration gas tank.
- J. Calibration gas tank contents are under pressure. Do not use oil, grease, or flammable solvents on the flow control or the calibration gas tank. Do not store calibration gas tank near heat or fire, nor in rooms used for habitation. Do not throw in fire, incinerate, or puncture.

2.4.2 Maintenance Procedures

- A. The primary maintenance item of the CGI Model MSA 361 is the rechargeable, 4.0-volt lead-acid battery. Using the appropriate battery charger (240 VAC), insert charger plug into charge jack.
- B. Use only the chargers specified above to charge the instrument; otherwise, damage to the battery pack and/or the instrument circuitry may result.
- C. The POWER ON lamp indicates that the charger is receiving power from the 240 VAC line. The FAST CHARGE lamp indicates that the battery voltage is low and that the charger has automatically switched to the higher charge rate.

- D. The battery pack may not supply full power capacity after repeated partial use between charging; therefore, it is recommended that the battery pack be “exercised” at least once per month by operating the fully charged instrument for 8 hours and then recharging.
- E. Recommended charging time is 16 hours.
- F. The battery pack should be charged after each day of use (or before use if the instrument has not been operated for 30 days).
- G. When the rechargeable 4.0-volt lead-acid battery pack no longer responds to recharging or no longer “holds” a charge, the pack should be replaced according to the following procedure:
 - 1. Loosen the knurled screws holding the handle and remove handle.
 - 2. Looking at the front panel of the instrument, remove the right (audible alarm side) panel by unscrewing the four side-panel screws.
 - 3. Gently pull the side panel loose and tilt the instrument to help slide out the battery case. Disconnect the molded nylon plug from the battery case. (NOTE: Do not disconnect the alarm speaker.)
 - 4. Install the new battery by reversing the above steps 1 through 3.

2.5 Horiba U-10 Water Quality Meter

2.5.1 Calibration Procedures

The calibration of the meter should be checked at the start of each day, and again during the day if there is a reason to suspect that the meter may be producing incorrect readings. The meter should be calibrated as follows:

- 1. Rinse the probe in distilled water. Be sure to remove the protective cap from the pH probe.
- 2. Fill the calibration beaker to about 2/3 with the standard solution. Note the line on the beaker. Fit the probe over the beaker.
- 3. Turn the unit on, and press the MODE key. The cursor should be on the AUTO sub-mode. If it is not, use the MODE key to move the cursor.

4. Press the ENTER key. The readout will show "Cal." The upper cursor will move across the screen as the four auto-calibration parameters are calibrated (pH, Cond, Turb, and DO). Once the cursor has stopped blinking, the auto-calibration is complete.
5. Should an error occur during calibration, the parameter where the error occurred will blink. Check the instruction manual for a list of error codes and redo the calibration.

2.5.2 Routine Preventive Maintenance and Storage

- A. Preventive maintenance protocol for the pH/conductivity meter involves replacement of the battery when the low battery is signaled on the LCD display. Replacement batteries will be available.
- B. The pH electrode should be covered by the provided protective cap when the meter is not in use. The protective cap should be removed prior to calibration.

2.6 DISSOLVED OXYGEN METER

2.6.1 Procedure for Calibration

- A. Place the probe in a water sample of known dissolved oxygen concentration composed of a freshly air-saturated water sample of known temperature.
- B. Consult a table, provided by the manufacturer, that lists the solubility of oxygen in water at different temperatures and pressures.

2.6.2 Calibration Schedule

Instrument readings should be checked every hour in sampling areas where the temperature is not constant. Otherwise, the instrument should be calibrated daily.

2.7 OIL/WATER INTERFACE PROBE

The oil/water interface probe will be used to measure groundwater and separate phase product levels in monitoring wells and tanks. The battery for the interface probe should be checked before and after each measurement is taken to ensure proper operation. Daily battery checks should also be performed before conducting any measurement activities. Replace the battery on a regular basis as specified in the operator's manual.

The probe should be thoroughly cleaned before and after each measurement, especially when measuring separate phase product levels. Removal all excess product and any sediment from the probe with a paper towel. Decontaminate the probe and graduated tape in accordance with SOP No. 500. Do not lower the probe all the way to the bottom of the well to avoid contact with bottom sediments and/or damaging the probe.

2.8 ELECTRONIC WATER LEVEL SOUNDER

The electronic water level sounder will be used to measure groundwater levels in monitoring wells. Check the battery for the sounder before and after each measurement to ensure proper operation. Perform daily battery checks before conducting any measurement activities. Replace the battery regularly as specified in the operator's manual. Decontaminate the sounder in accordance with SOP No. 500.

3.0 DOCUMENTATION

- A. The following information will be kept on file in the field trailer:
 - 1. Calibration certifications provided by the manufacturer or other outside agency (periodic calibrations only).
 - 2. Date of last calibration and date when next calibration is due.
 - 3. Manufacturer's operating instructions.
 - 4. Manufacturer's calibration and maintenance instructions.
 - 5. Nearby location for purchase of spare and replacement parts (when applicable).
- B. General information that must be recorded for each measuring device is listed below:
 - 1. Name of equipment
 - 2. Equipment identification/serial number
 - 3. Manufacturer
 - 4. Calibration frequency (daily, weekly, monthly, etc.)
- C. The following calibration information will be recorded in the field logbook:
 - 1. Name of equipment

2. Equipment identification/serial number
3. Date and time of calibration/maintenance check
4. Results of calibration
5. Signature/initials of individual who performed the calibration
6. Description of maintenance performed

TABLES

TABLE 930-1
Relative Photoionization Sensitivities of
Various Gases to a 10.2 eV Lamp

Gas	Photoionization Sensitivity ¹	Span Control Setting for Direct Reading Approximately
P-xylene	11.4	
M-xylene	11.2	
Benzene	10.0	
Toluene	10.0 (reference standard)	9.8
Diethyl sulfide	10.0	
Diethyl amine	9.9	
Styrene	9.7	
Trichloroethylene	8.9	9.2
Carbon disulfide	7.1	
Isobutylene	7.0	
Acetone	6.3	
Tetrahydrofuran	6.0	5.5
Methyl ethyl ketone	5.7	
Methyl isobutyl ketone	5.7	
Cyclohexanone	5.1	
Naptha (85% aromatics)	5.0	
Vinyl chloride	5.0	4.3
Methyl isocyanate	4.5	
Iodine	4.5	
Methyl mercaptan	4.3	
Dimethyl sulfide	4.3	
Allyl alcohol	4.2	
Propylene	4.0	3.5
Mineral spirits	4.0	
2,3-dichloropropene	4.0	
Cycloexene	3.4	
Crotonaldehyde	3.1	
Acrolein	3.1	
Methyl methacrylate	3.0	2.4
Pyridine	3.0	
Hydrogen sulfide	2.8	
Ethylene dibromide	2.7	1.9
N-octane	2.5	
Acetaldehyde oxime	2.3	
Hexane	2.2	
Phosphine	2.0	
Heptane	1.7	
Allyl Chloride	1.5	
(2-chloropropene) ethylene		
Isopropanol	1.0	0.1
Ethylene oxide	1.0	
Acetic Anhydride	1.0	
Alpha pinene	0.7	
Dibromochloropropane	0.7	
Epichlorohydrin	0.7	
Nitric oxide	0.6	
Beta pinene	0.5	
Citral	0.5	
Ammonia	0.3	
Acetic acid	0.1	
Nitrogen dioxide	0.02	
Methane	0.0	
Acetylene	0.0	

NOTES:

¹ PPM reading when measuring 10.0 ppm of particular gas with monitor calibrated for benzene

EXHIBIT 8b

ACTIVE EQUIPMENT LOG

[illegible]

Lockformer Work Plan QAPP
Date: 2/28/2003
65263.01- Rev.3

ATTACHMENT B

FIRST ENVIRONMENTAL LABORATORIES STANDARD OPERATING PROCEDURES

First Environmental Laboratories

Standard Operating Procedure

Title: Sample Login, Entry and Reporting

Summary of Purpose: This SOP describes the procedures for logging samples into the laboratory information management system (LIMS), entering sample results and creating client sample reports.

1. Sample Log-in

1.1. At sample login a sample file is created using Microsoft Excel™. Use the appropriate login master template according to the parameters requested and/or any special format requested by the client. This template is the form that the final report will take. Project specific information is entered in the various fields.

1.2. Login master templates are stored in the "login" subdirectory in Excel™.

1.3. Login master templates may be created or edited as required. Master templates are normally created for a specific parameter list or a special client format.

1.4. The newly created sample file should be saved in the "samples" subdirectory in Excel™. The assigned range of sample numbers is the File ID (e.g. 12345-67.xls). When creating the sample file remember not to overwrite the login master template. Use the "save as" function of the spreadsheet software.

1.5. The sample file is printed and included in the project folder.

1.6. The project folder and sample file is reviewed by the Project Manager to confirm the accuracy of the following entries:

- Client
- Project ID
- Sample Number
- Sample Description
- File ID
- Date Received
- Date Taken
- Time Taken
- Analytical Request

- Unit of Measure
- Method Reference
- Special Instructions

1.7. The Project Manager initials the project folder after review is complete

2. Results Entry & Formatting

2.1. Results Entry

2.1.1. The analyst responsible for performing a specific analysis is responsible for reviewing the analytical data and QC data for compliance with method requirements.

2.1.2. The analyst is also responsible for entering the results of the analysis into the sample file. When entering results, the sample file will be found in the "samples" subdirectory in ExcelTM, using the File ID (e.g. 12345-67.xls).

2.1.3. Another analyst or supervisor must review results of analyses conducted by an analyst-in-training or a technician.

2.1.4. The sample results will be entered along with the date of analysis. If the holding time for the sample preparation or analysis is less than 48 hours, then the time of analysis will also be entered. The appropriateness of the unit of measure and method reference and revision listed in the sample file will be confirmed. If necessary, a correction will be made.

2.1.5. Before exiting Excel, the sample file will be saved and closed.

2.1.6. The analyst will then indicate that the parameters have been entered into the sample file by initialing the project file. The analyst responsible for a specific data entry can be uniquely identified by this notation.

2.1.7. If any deviations from routine protocols have occurred or if any QC indicator associated with the batch failed to pass acceptance criteria, then the analyst will include a case narrative in the project file detailing the deviation or failure.

2.1.8. The analyst that enters the last result will forward the project file to the Project Manager. The Project Manager is responsible for generating the final Analytical Report.

2.2. Significant Figures

All digits in a reported result are expected to be known definitely, except for the last digit, which may be in doubt. If more than a single doubtful digit is carried, the extra digit or digits are not significant. Report only such figures as are justified by the accuracy of the work. The reporting limits routinely used by the laboratory establishes significant figures for results. If the sample is analyzed at a dilution the number of significant figures used for reporting is adjusted accordingly.

Example:

Routine reporting limit for nitrite is 0.01 mg/L

If the sample was analyzed at a 10x, the reporting limit changes to 0.1 mg/L

If the sample was analyzed at a 100 x, the reporting limit changes to 1 mg/L

2.3. Rounding

Round off by dropping digits that are not significant. If the digit 6,7,8,9 is dropped, increase preceding digit by one unit; if the digit 0,1,2,3,4 is dropped, do not alter preceding digit. If the digit 5 is dropped, round off preceding digit to the nearest even number.

Example:

2.25 becomes 2.2 and 2.35 becomes 2.4

Generally, First Environmental does not report more than three significant figures

Example:

11,642 becomes 11,600

1,162 becomes 1,160

2.4. Ambiguous Zeros

In a number written as 5.00, it is understood that all the zeros are significant, or else the number could have been rounded off to 5.0, 5 or whichever was appropriate.

In a number written as 0.52, the zero serves as a place holder. This avoids possible questioning in regards to a real number being excluded (.52).

2.5. Dry Weight vs. Wet Weight

2.5.1. Results for waste analyses (with the exception of TCLP analyses) are expressed on an "as is" basis (i.e., the sample results are not corrected for percent moisture). This is in accordance with protocols for "waste" materials.

2.5.2. Results for soils, sediments, and sludges are expressed on a dry weight basis per method protocols.

2.6. Data Quality Flags

The following data flags may be used to qualify the data.

"J": Indicates an estimated concentration. This flag is used when reporting a result that is less than the routine reporting limit but greater than the method detection limit.

"B": Indicates the analyte was found in the associated blank as well as the sample. Common lab contaminants include, acetone, 2-butanone, and methylene chloride..

"E": Indicates an estimated value. This flag may be used when the internal standard recovery for the associated compounds fails to meet acceptance criteria. Failure to meet acceptance criteria is due to the presence of a matrix interference. It may also be used to indicate the reported value exceeds the calibration range of the instrument.

3. Results Reporting

3.1. When all results for the requested parameters have been entered, a final report is generated on company letterhead by the Project Manager.

3.2. The Project Manager will review the results and prepare a cover letter or case narrative detailing any deviations from routine protocols that have occurred or failures to meet data quality objectives.

3.3. The Project Managers data review includes:

- Accuracy and completeness
- Chemical relationships, i.e., COD/BOD/TOC, TKN/HN₃ etc.
- Historical results
- Consistency in reporting
- Units of Measure
- Significant Figures
- Detection Limits
- QA/QC

3.4. The final Analytical Report will include the following:

- Cover Letter or Case Narrative
- Analytical Report(s)
- Chain-of-Custody Record

3.5. The cover letter or case narrative includes the following:

- Date of Final Report Preparation
- Client Name and Address
- Project ID
- First Environmental File ID
- Date Samples Received
- Project Summary, consisting of the following:
 - Statement regarding whether results for solid sample matrices are reported on a dry weight or wet weight basis.
 - Project specific information detailing deviations from routine protocols or QC failures associated with the sample batch.
 - Reference to sampling procedure when the laboratory collected the sample.
 - Statement regarding compliance with current certification requirements and / or quality control criteria outlined in the method(s).
 - Source of Method References
 - Listing of subcontracted analyses and subcontractor
 - Signature and Title of Project Manager

3.6. After the report is generated, the Project Manager will initial and date the project file indicating that final review and report generation is complete.

3.7. A second Project Manager will review the completed report. Once that review is complete, they will also initial and date the project file.

3.8. At this point, the project file is forwarded to the office for report delivery, invoicing, and mailing.

4. Report Delivery

4.1. All reports are forwarded to the client via facsimile or E-mail.

4.2. A client may request that the sample results be transmitted in an electronic format (e.g. diskette or e-mail). If an e-mail is requested, the appropriate Excel results file should be sent as an attachment to the address supplied by the client. E-mail addresses are kept in a permanent electronic "rolodex" located on the file server computer.

4.3. Data transmitted electronically or by facsimile should contain a confidentiality statement or stamp.

"The pages accompanying this facsimile transmission contain information, which is confidential or privileged. The information is intended to be for the use of the individual or entity named above. If you are not the intended recipient, be aware that any disclosure, copying, distribution or use of the contents of this information is prohibited. If you have received this facsimile in error, please notify us immediately so that we can arrange for the retrieval of the original documents at no cost to you."

4.4. Data sent on diskette should be accompanied by a cover letter describing the contents of the diskette. The diskette should also be clearly labeled as to its contents.

5. Report Invoicing & Mailing

5.1. The invoice is prepared in accordance with specific account information available in the rolodex. The number of invoiced analyses is verified against the number of samples listed on the COC.

5.2. The final Analytical Report(s), supporting documentation such as COCs, and the invoice are forwarded to the client via regular mail.

6. Data Archiving

6.1. The sample file resides in the "samples" subdirectory in ExcelTM until the report is complete and the project has been invoiced.

6.2. After invoicing, the sample file is then moved to the "reported samples" subdirectory in ExcelTM.

6.3. The sample file will remain in this subdirectory until the file server requires additional disk space. When this occurs, the sample files will be moved to magnetic media and kept for a minimum of 10 years.

6.5. All data files that are currently in the "samples" or "reported samples" subdirectory will be backed up daily to magnetic media.

7. Corrected Reports

In the event that a measurement / reporting error is detected after the issuance of the final report, the Project Manager will notify the client.

When a report must be revised after final issue the following format (or comparable) will be utilized:

01 June 1994

Mr. James Client
NAME IN CAPS/BOLD
101 Main Street
Anywhere, IL 60111

Dear Mr. Client:

RE: Revised Report

Project ID:
First Environmental File ID:
Date Received:

The following report has been revised as follows:

I thank you for the opportunity to be of service to you and look forward to working with you again in the future. Should you have any questions regarding any of the enclosed analytical data or need additional information, please contact me at (630) 778-1200.

Sincerely,

Stan Zaworski (or)
William H. Mottashed
Project Manager

8. Notes

8.1. Tips and Hints

A thorough knowledge and understanding of Microsoft Excel is helpful when entering results. The user should be familiar with the on-line help that is available in ExcelTM.

9. Approvals

Reviewed for Technical Accuracy by: _____

Reviewed for Quality Assurance Compliance by: _____

Implementation Date: _____

End Use Date: _____

First Environmental Laboratories

Standard Operating Procedure

Title: Summary of Quality Control Indicators – Organics Analyses

This is an internal document based on information contained in various regulatory documents.

1. Summary of Purpose

1.1. It is the purpose of this SOP to provide detailed information pertaining to quality control requirements associated with performing GC and GC/MS analyses. Quality Control Indicators (QCIs) provide an indication of the acceptability of the data that can be easily assessed through the use of method specifications and/or the use of tabulations or control charts.

The following information is provided for each quality control indicator (QCI) where applicable:

- purpose and definition of use
- frequency of analysis
- acceptance criteria
- example calculation
- corrective action
- documentation requirements

In some cases, additional SOPs have been prepared, which provide the detailed instructions that support meeting the actual requirement. See section 10 of this SOP

1.2. A summary of acronyms is provided in Section 2. For reference.

1.3. Part 186, Accreditation of Laboratories for Drinking Water, Wastewater, and Hazardous Waste Analyses establishes standards for QC. The information in Sections 2 complies with Part 186. The rules state:

“The laboratory shall follow all quality control procedures in the approved test method. The laboratory shall utilize the quality control procedures set forth in this Section if the approved test method does not specify any quality control procedures or the quality control procedures contained in the approved test method are less stringent.”

Modifications are made within the method specific SOP to accommodate the particular requirements associated with the method of analysis. The requirements of the method SOP may be stricter than those detailed in this generic SOP and this generic SOP may be

stricter than Part 186 Section 2 requirements. Section 7 of this SOP provides summaries of the QCIs based on the type of determinative procedure, e.g., GC vs. GC/MS.

2.0. Summary of Acronyms used by First Environmental Laboratories:

Note: see Definitions SOP for additional detail.

%RSD = Percent Relative Standard Deviation

% R = Percent Recovery

CB = Calibration Blank

cc = correlation coefficient

CCB = Continuing Calibration Blank

CCC = Calibration Check Compound

CCVS = Continuing Calibration Verification Standard

LFB = Laboratory Fortified Blank (same as LCS)

LRB = Laboratory Reagent Blank (same as PB)

ICB = Initial Calibration Blank

ICVS = Initial Calibration Verification Standard

IDC = Initial Demonstration of Capability

IDMP = Initial Demonstration of Method Performance

IEC = Interelement Correction

LCS = Laboratory Control Standard (same as Laboratory Fortified Blank)

LDR = Linear Dynamic Range

MDL = Method Detection Limit

MS = Matrix Spike

MSD = Matrix Spike Duplicate

PB = Procedure Blank (same as Laboratory Reagent Blank)

QCI = Quality Control Indicator

QCS = Quality Control Sample

RB = Reagent Blank

RPD = Relative Percent Difference

SPCC = System Performance Check Compound

3. Initial Demonstration of Capability/Initial Demonstration of Method Performance

3.1 Purpose: The IDC/IDMP verifies and demonstrates that the instrument, method, and/or analyst is capable of generating precise and accurate analytical data. It is used to validate new analyst and new instrument performance, and to validate changes in analytical equipment or technique.

A quality control (QC) check sample shall be obtained from an appropriate source, such as ERA, APG, NSI or USEPA. If not available, the QC check sample may be prepared using calibration standards that are prepared at a different time than those used in instrument calibration. Four aliquots of a QC check sample prepared at a concentration equal to 10-50 times the MDL are analyzed according to the method. The QC check samples are processed through the entire analytical procedure, including sample preparation.

3.2. Frequency: IDMP must be repeated whenever a significant change in the method or instrumentation occurs. IDC samples are analyzed as part of analyst training and certification.

3.3. Acceptance Criteria: Calculate the mean value, mean percent recovery, standard deviation of replicates, and percent relative standard deviation of replicates for each analyte. Compare mean percent recovery to the corresponding acceptance criteria for precision and accuracy in the approved test method. If information is not available, refer to Table 1020 I in the 18th Edition of Standard Methods. The percent relative standard deviation should be less than 20.

3.4. Example Calculations: See the IDC / IDMP SOP

3.5. Corrective Action: If the IDC/IDMP fails, the source of the problem will need to be identified and corrected, and the IDC will need to be re-analyzed. It may be necessary to actually re-prepare the validation samples.

3.6. Documentation Requirements: The raw data and calculations supporting the IDC/ICMP should be easily retrievable. Since the IDC/IDMP is performed for a variety of reasons, the data should be filed in a manner consistent with the event, e.g., file in either the analysts training file, the method validation file, or the instrument validation file. A log is kept recording the method and date that IDC/IDMPs are performed. The log also identifies the analyst responsible for performing the analysis.

4. Method Detection Limit Study

4.1. Purpose: The results of MDL study define the level of detection for a particular method, in a given matrix, having a specified degree of confidence. FR, Vol. 49, No. 209, 10/26/84, defines the MDL as follows: "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte." In the laboratory, the matrix is normally defined as deionized (DI) water for the initial determination. If necessary, additional studies can be performed for other matrices such as soil. If requested, MDL studies could be performed for the actual matrix of sample submitted by the client.

Determination of the MDL requires that the test sample aliquot be processed through all stages of sample preparation normally associated with the analysis of a particular matrix, i.e., extraction.

4.2. Frequency: MDL studies are performed annually per instrument type or when there is a change in instrument type.

4.3. Acceptance Criteria

- The calculated MDL must be greater than $1/10^{\text{th}}$ the MDL spiking concentration.
- The calculated MDL must be greater than "0".
- The MDL spiking concentration must be greater than the calculated MDL.
- For drinking water accreditation, the MDL must be equal to or less than those specified in Section 186 Appendix A. (Document on file)
- The mean percent recovery must be $\pm 50\%$ or per method requirements.

Routine reporting limits have been established for both aqueous and solid sample matrices. Generally, the reporting limit is two to five times higher than the MDL. If necessary, results can be reported below the routine reporting limit, but in no case shall results be reported below the MDL.

4.4. Example Calculations: See the Method Detection Limit SOP

4.5. Corrective Action: If the criterion is not met, re-evaluate the spiking concentration chosen for performing the study. The MDL is a calculation based on the standard deviation of a set of data. The standard deviation will be larger when the data set is more variable and smaller when the data set is less variable. Inappropriate choice of spike concentration can result in data that is falsely variable or falsely stable.

4.6. Documentation Requirements: The raw data and calculations supporting MDL studies must be easily retrieved.

5. Calibration Curve

5.1. Purpose: A calibration curve relates instrument response to sample concentration. It also proves that the instrument response, over a determined concentration range, can be predicted using a mathematical equation.

An initial calibration curve requires a minimum of five standards evenly distributed throughout the range of the analysis. The data must be collected under the same conditions as those that will exist during routine analyses.

Prepare a calibration curve by plotting the response of standards versus the corresponding concentrations. Automatic calibration software will be used to calculate and store the response factors that are generated in the calibration.

5.2 Frequency: A new calibration curve is prepared as necessary. Changes in instrument or reagent conditions, which result in failure to obtain an acceptable response for the CCVS, would indicate the need to prepare a new curve.

5.3 Acceptance Criteria

5.3.1 Acceptance Criteria GC/MS: The %RSD for the Calibration Check Compounds (CCC) must be equal to or less than 30%. If the RSD of any target analyte is 15% or less, then the response factor is assumed to be constant over the calibration range, and the average response factor may be used for quantitation. If the RSD of any target analyte is greater than 15%, a linear regression or quadratic regression may be used for quantitation.

System Performance Check Compounds (SPCC) must meet the minimum response as detailed in the method SOP.

5.3.2. Acceptance Criteria GC: The %RSD for the target compounds must be equal to or less than 20%. (<10% for method 608.)

5.4. Example Calculation: See the Calibration Curve SOP

5.5. Corrective Action: Since the calibration curve is used for calculating results for all samples and quality control indicators, a curve meeting all requirements must be established prior to analyzing client samples.

5.6. Documentation Requirements: The raw data and calculations supporting the use of a calibration curve must be easily retrieved. Generate a response factor summary report and store along with the raw data in the daily QC file package.

6. Daily QCIs

Quality control indicators are analyzed at specific frequencies and have specific acceptance criteria that must be met in order to accept the sample data. The acceptance criteria are in place to help analysts recognize the need for corrective action. Any quality control indicators that fail to meet acceptance criteria require some form of corrective action. Often an analyst's experience will allow them to initiate immediate corrective action at the bench. All corrective actions should be documented appropriately.

If a sample batch is still out-of-control after reanalysis and nonconformance is designated as method related rather than sample related, then activities related to performing the method shall stop immediately. A detailed investigation will be conducted to isolate and correct the problem.

The analyst is responsible for the following:

- accessing the data set and the acceptability of each QCI
- initiating the appropriate corrective action when a QCI has failed to meet acceptance criteria
- documenting corrective actions taken
- qualifying the data appropriately using the laboratory case narrative form

6.1. Initial Calibration Verification

6.1.1. Purpose: An ICVS verifies that the standards used to construct the curve were chemically pure, prepared properly, and that they have not degraded significantly since they were made. The ICVS should be obtained from a different source than that used to prepare the standards for constructing the calibration curve. The concentration of the ICVS should be 10%-50% of the maximum calibration range unless specified otherwise in the method. Ideally, the source is a different manufacturer altogether and the manufacturer predetermines the concentration. This standard does not go through sample preparation.

6.1.2. Frequency: Analyze an ICVS immediately following a calibration curve to verify the curve. An ICVS must be analyzed with every calibration curve.

6.1.3. Acceptance Criteria: The result must be within 85-115% unless specified otherwise in method.

6.1.3.1. Generally; Methods from the EPA document titled, "Methods for Chemical Analysis of Water and Waste," EPA/600/4-79-020, require the ICVS to have 90-110% recovery.

6.1.3.2. Methods from the EPA document titled, "Test Methods for Evaluating Solid Waste Physical / Chemical Methods," SW-846, 3rd Edition and its' updates, require the ICVS to have 85-115% recovery.

6.1.4. Example Calculation: $\%R = \frac{\text{Obtained Value}}{\text{True Value}} \times 100$

6.1.5. Corrective Action: If the ICVS fails, re-evaluate the calibration curve to verify that all criteria have been met. Verify the acceptability of the sources used for constructing the calibration curve and for preparing the ICVS. Evaluate the concentration of the ICVS compared to the linear range of the analysis and the reporting limit. Re-run the ICVS and check standard reanalysis as follows:

- Sample analyses may continue for the analytes for which the results of the reanalysis of the ICVS check standard meet the acceptance criteria.
- Terminate sample analyses or reject sample analyses data for the analytes for which the results of the reanalysis of the ICVS check standard fail to meet the acceptance criteria.
- Sample analyses may proceed for the analytes for which the acceptance criteria were not met only after the establishment and verification of a new initial calibration curve.

6.1.6. Documentation Requirements: Record the percent recovery on the raw data and file with the initial calibration curve data. Record corrective action taken when the ICVS fails to meet acceptance criteria.

6.2. Calibration and Continuing Calibration Verification Standard

6.2.1. Purpose: The CCVS verifies that the analysis is in control with respect to the most recent initial calibration curve.

The CCVS is subjected to the same conditions and procedures as a non-prepared sample. The CCVS may be prepared from the same source of the initial calibration curve standards or from a second source material. The concentration of the CCVS should be 25%-50% of the maximum calibration range unless specified otherwise in the method.

6.2.2. Frequency GC/MS: Every 12 hours, at the beginning of the analytical batch.

6.2.3. Frequency GC: At the beginning of the analytical batch prior to sample analysis, after 12 hours or 20 twenty samples and at the end of the analytical batch.

6.2.4. Acceptance Criteria

6.2.4.1 Acceptance Criteria GC/MS: The percent difference from the initial calibration for each Continuing Calibration Compound (CCC) must be less than or equal to 20%. The SPCC compounds must meet the minimum response as stated in the analytical method SOP.

6.2.4.2 Acceptance Criteria GC: The percent difference for each compound must be less than or equal to 15%.

6.2.5. Example Calculation: % difference = $\frac{[(\text{curve response} - \text{CCVS response})]}{\text{Curve Response}} * 100$

6.2.6. Corrective Action: Two possible courses of action include: Re-tune the GC/MS system, or perform routine inlet maintenance on the GC.

6.2.7. Documentation Requirements: A summary form showing the percent difference calculations will be generated from the computer data system and filed with the daily QC package.

6.3. Method Blank

6.3.1. Purpose: The method blank monitors method performance. A method blank that contains no target compounds demonstrates that the apparatus and glassware used to perform sample preparation is free of contamination.

The method blank is an aliquot of DI water that is processed through all stages of sample preparation.

The method blank amount of any target compound found will not be subtracted from the sample amount.

6.3.2. Frequency: When samples require a preparation, a method blank must be analyzed with each batch of samples. A batch of samples is defined as one to twenty environmental samples of the same matrix that are prepared together with the same process and personnel, using the same lot of reagents with a maximum time between the start of processing of the first sample and the start of processing of the last sample being 24 hours.

6.3.3. Acceptance Criteria: Rule of Thumb: The method blank must be less than the reporting limit.

6.3.4. Example Calculation: Not Applicable

6.3.5. Corrective Action:

If the concentration of the blank is above the reporting limit and a sample has a concentration greater than 10x the level of the blank, the sample can be reported. The report should be flagged or details should be provided in a case narrative.

If the concentration of the blank is above the reporting limit and a sample has a concentration less than 10x the level of the blank, the sample needs to be re-prepared and re-analyzed.

If the concentration of the blank is above the reporting limit but the sample has a concentration below the reporting limit, the sample can be reported.

If positive values below the reporting limit are observed, they should be evaluated in relation to the sample(s) and extra care should be taken to avoid reporting false positives.

6.3.6. Documentation Requirements: Record the concentration of the method blank on the raw data. Record corrective action taken when the blank fails to meet acceptance criteria.

6.4. Laboratory Control Standard

6.4.1. Purpose: The LCS monitors method performance and the efficiency of the entire analysis, including sample preparation. The results of the LCS are used to validate an analytical batch when the MS/MSD is outside control limits.

The concentration of the LCS is normally equivalent to 50-100% of the calibration range. It is processed through all stages of sample preparation.

An LCS is not applicable for analytes for which spike solutions are not available.

The LCS shall be obtained from a secondary source other than the source of the calibration standards, if applicable.

6.4.2. Frequency: An LCS should be analyzed with each batch of samples. A batch of samples is defined as one to twenty environmental samples of the same matrix that are prepared together with the same process and personnel, using the same lot of reagents with a maximum time between the start of processing of the first sample and the start of processing of the last sample being 24 hours.

6.4.3. Acceptance Criteria: If the analysis normally requires an LCS to be analyzed, statistical control limits should be generated for the LCS. After a database of 20-30 points has been collected, calculate the mean expressed as percent recovery and the standard deviation (s).

Control Limit = mean \pm 3s

Warning Limit = mean \pm 2s

The control limits and warning limits are updated semi-annually or whenever the process is changed.

6.4.4. Example Calculation: $\%R = \frac{\text{Obtained Value}}{\text{True Value}} \times 100$

6.4.5. Corrective Action: The inability to successfully analyze the LCS indicates a problem potentially related to the sample preparation procedures. This is especially true if the CCVS was in-control. If the control windows are exceeded, determine the cause and correct the problem. All samples associated with the failed LCS should be re-prepared and re-analyzed.

6.4.6. Documentation Requirements: Summarize the LCS results and include with the raw data in the daily QC package. Record corrective action taken when the LCS fails to meet acceptance criteria.

6.5. Matrix Spike / Matrix Spike Duplicate:

6.5.1. Purpose: The MS/MSD monitors the precision and accuracy of the procedure for a specific matrix.

The MS/MSD pair are two separate aliquots of sample, which are spiked with known concentration of analyte and then are processed through all stages of sample preparation. The concentration of the spike should be between 20-50% of the range of the analysis.

An MS/MSD is not applicable for analytes for which a spike solution is not available.

The selection of the sample chosen for the MS/MSD will be arbitrary, whenever possible.

6.5.2. Frequency: An MS/MSD must be analyzed with each batch of samples. A batch of samples is defined as one to twenty environmental samples of the same matrix that are prepared together with the same process and personnel, using the same lot of reagents with a maximum time between the start of processing of the first sample and the start of processing of the last sample being 24 hours.

6.5.3. Acceptance Criteria: Interim criteria requires that the %R of the MS/MSD to be within 75-125% of the true value. Statistical control limits should be generated for the MS/MSD for common matrices. At a minimum, control limits should be generated for aqueous and non-aqueous matrices. After a database of 20-30 points has been collected, calculate the mean expressed as percent recovery and the standard deviation (s).

Control Limit = mean \pm 3s

Warning Limit = mean \pm 2s

The control limits and warning limits are updated semi-annually or whenever the process is changed.

The RPD should be ≤ 20 .

6.5.4. Example Calculation:

$$\%R = \frac{\text{spiked sample concentration} - \text{unspiked sample concentration}}{\text{concentration of spike}} \times 100$$

$$RPD = |(Difference/Average)| \times 100$$

6.5.5. Corrective Action: No action is taken on out of control MS/MSD data alone to qualify an entire batch. Action taken must be weighed carefully since it may be difficult to determine if poor precision and/or accuracy is a result of sample non-homogeneity, uniqueness, method defects, or laboratory technique. However, the data may be used in conjunction with other QCI information to determine the need for qualifying the data. If the MS/MSD data is outside acceptance limits, check the %R or RPD of the LCS. If the LCS is in control, the procedure is in control and the data is acceptable.

If the concentration of an analyte in the client sample is greater than 4 times the level of the spike, then the spiking level is insignificant to the sample and skewed spike recoveries may result.

If an MS/MSD sample is diluted and the concentration of the spiked sample meets the above conditions, then the spike may be diluted out.

6.5.6. Documentation Requirements: Summarize the MS/MSD results and include with the raw data in the daily QC package. Record corrective action taken when the MS/MSD fails to meet acceptance criteria.

6.6. Duplicate

6.6.1. Purpose: In some instances, it is not practical or possible to spike the sample. When this is the case, a duplicate sample analysis is performed in place of the MS/MSD. The duplicate evaluates the precision of the analysis for a particular matrix. The duplicate is a separate aliquot of sample that is processed through all stages of sample preparation.

6.6.2. Frequency: When performed in place of an MS/MSD, one duplicate will be analyzed for every analytical batch (or twenty samples).

6.6.3. Acceptance Criteria: Interim criteria require the RPD to be ≤ 20 . If the original and/or the duplicate values are $< 5x$'s the reporting limit, then the advisory control limit becomes \pm the reporting limit for aqueous samples, and $\pm 2x$'s the reporting for solid samples.

6.6.4. Example Calculation:

$$RPD = |(Difference/Average)| * 100$$

6.6.5. Corrective Action: No action is taken on out of control duplicate data alone to qualify an entire batch. Action taken must be weighed carefully since it may be difficult to determine if poor precision is a result of sample non-homogeneity, uniqueness, method defects or laboratory technique. However, the data may be used in conjunction with other QCI information to determine the need for qualifying the data. If the duplicate data is outside acceptance limits, check %R of the LCS. If the LCS is in control, the procedure is in control and the data is acceptable.

6.6.6. Documentation Requirements: Record the percent recoveries and the RPD on the raw data.

6.7. System Monitoring Compounds (Surrogates)

6.7.1. Purpose: A System Monitoring Compound is an organic compound which is similar to the target analytes in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. These compounds are added to each sample to determine matrix effects and analyte recovery after sample analysis.

6.7.2. Frequency: These compounds should be added to every sample, spike and method blank.

6.7.3. Acceptance Criteria: Interim criteria require the recoveries to be within limits specified in the analytical method. Statistical control limits should be generated for each compound for common matrices. At a minimum, control limits should be generated for aqueous and non-aqueous matrices. After a database of 20-30 points has been collected, calculate the mean expressed as percent recovery and the standard deviation (s).

Control Limit = mean \pm 3s

The control limits are updated semi-annually or whenever the process is changed.

6.7.4. Example Calculation:

$$\%R = \frac{\text{spiked sample concentration} \times 100}{\text{concentration of spike}}$$

6.7.5. Corrective Action: If a system monitoring compound recovery is outside control limits, the sample is to be re-analyzed. If the duplicate data is also outside acceptance limits, the procedure is in control, there is a sample matrix effect and the data is acceptable.

6.7.6. Documentation Requirements: Record the percent recoveries on the raw data. Record corrective action taken when the surrogate fails to meet acceptance criteria.

6.8. Case Narrative and Use of Data Flags

6.8.1. Deviations from routine protocols are not accepted unless approved by a Project Manager, Laboratory Supervisor, or Director of Quality Assurance. Failure to meet any QC objective should be documented in a case narrative included with the sample data forwarded to the Project Manager.

6.8.2. Exception: If the MS/MSD analysis fails to meet acceptance criteria, a case narrative is included only with the sample data from which the MS/MSD sample originated.

6.8.3. The Project Manager is responsible for including appropriate information pertaining to the sample analyses in the cover letter sent with the final Analytical Report to the client. The following data flags may be used to qualify the data:

“U”: The analyte was analyzed for but not detected.

“<”: The analyte was analyzed for but not detected.

"J": Indicates an estimated concentration. This flag is used when estimating a concentration of a tentatively identified compound, or if reporting a result that is less than the required quantitation limit.

"B": Indicates the analyte was found in the associated blank as well as the sample.

"D": Indicates that a dilution has been performed.

"P": Indicates the associated result may be of poor precision (high variability). This flag is also used to indicate failure to meet QC criteria for duplicate sample analysis.

"H": Indicates the associated result may overestimate the true value. This flag is also used to indicate failure to meet QC criteria for spike sample analysis.

"L": Indicates the associated result may underestimate the true value. This flag is also used to indicate failure to meet QC criteria for spike sample analysis.

7. Summary of Quality Control Indicators

7.1 GC/MS Quality Control Indicators

Quality Control Indicator (QCI)	Frequency	Control Limit (Interim)	Control Limit (Statistical)	Initial Corrective Action
System Tuning Compound	The start of every 12 hour sequence	See Method SOP	NA	Re-Tune system electronics
Initial Calibration Curve	Referenced	CCCs must be <30% RSD and SPCC > specified RRF.	NA	Identify problems; Re-analyze calibration curve.
Initial Calibration Verification (ICVS)	Immediately following the curve	$\pm 15\%$ or within stated limits	As supplied by manufacturer	Re-evaluate the calibration curve to verify that all criteria have been met.
Continuing Calibration Verification Standard (CCVS)	Once every 12 hour sequence prior to sample analysis.	CCCs must be less than 20% difference from Initial Calibration	NA	Inspect instrument for causes; re-analyze calibration standard.
Method Blank	Per batch of samples	Less than the reporting limit	NA	Check for cont. problems; Re-analyze blank.
Laboratory Control Standard (LCS)	Per batch of samples	Per method SOP	3 standard deviations for the control limit and 2 standard deviations for the warning limit*	Determine cause of problem and re-prepare and re-analyze the affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) - concentration	Once per 20 or fewer samples per matrix type, per sample extraction or preparation procedure.	Per method SOP	3 standard deviations for the control limit and 2 standard deviation for the warning limit	Evaluate the LCS with respect to the MS/MSD. If the LCS was acceptable, evaluate the sample for matrix interferences.
Surrogate or System Monitoring Compounds	Every analytical sample.	Per method SOP	3 standard deviations for the control limit and 2 std devs for the warning limit	Re-analyze sample to check for matrix effect.
Internal Standard Areas	Every analytical sample	Areas must be $\pm 50\%$ of the CCVS internal standards	NA	Re-analyze sample to check for matrix effect.

Note: The above table is "generic" and does not replace method specific requirements listed in the method SOP.

7.2 GC Quality Control Indicators

Quality Control Indicator (QCI)	Frequency	Control Limit (Interim)	Control Limit (Statistical)	Initial Corrective Action
Endrin/DDT Breakdown check.	The start of every 12 hour sequence	<15% breakdown for each compound.	NA	Perform injection port maintenance.
Initial Calibration Curve	Referenced	All compounds must be <20% RSD (<10% for method 608).	NA	Identify problems; Re-analyze calibration curve.
Initial Calibration Verification (ICVS)	Immediately following the curve	$\pm 15\%$ or within stated limits ($\pm 10\%$ for method 608).	As supplied by manufacturer	Re-evaluate the calibration curve to verify that all criteria have been met.
Continuing Calibration Verification Standard (CCVS)	Beginning of sequence prior to sample analysis, after 12 hr or 20 samples and at end of sequence.	Compounds must be less than 15% difference from Initial Calibration	NA	Inspect instrument for causes; re-analyze calibration standard.
Method Blank	Per batch of samples	Less than the reporting limit	NA	Check for contamination problems; Re-analyze blank.
Laboratory Control Standard (LCS)	Per batch of samples	Per method SOP	3 standard deviations for the control limit and 2 standard deviations for the warning limit*	Determine cause of problem and re-prepare and re-analyze the affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD)	Once per 20 or fewer samples per matrix type, per sample extraction or preparation procedure	Per method SOP	3 standard deviations for the control limit and 2 standard deviation for the warning limit	Evaluate the LCS with respect to the MS/MSD. If the LCS was acceptable, evaluate the sample for matrix interferences.
Surrogate or System Monitoring Compounds	Every analytical sample	Per method SOP	3 standard deviations for the control limit and 2 standard deviation for the warning limit	Re-analyze sample to check for matrix effect.

Note: The above table is "generic" and does not replace method specific requirements listed in the method SOP.

8 Holding Times

Failures to meet holding times for any analysis should be documented in the laboratory case narrative included with the sample data forwarded to the Project Manager. The final report and data should be flagged accordingly.

9 Standards Tracking and Traceability

9.1. The degree of uncertainty in an analytical process is greater than or equal to the uncertainty in the applied standards. Chemical standards ordinarily are prepared by quantitatively combining constituents of known purity. The purity of the source of the material used for preparing the standards used for constructing the calibration curve standards and for preparing other quality control standards such as, matrix spikes and laboratory control standards, cannot be automatically assumed.

9.2. Similarly, the stability of standards is also a prime requirement. Every standard should have an assigned expiration date indicating its stable life expectancy and should not be used beyond such date.

9.3. All standards and reagents should be purchased from reputable scientific or standard supply firms recognized by the environmental laboratory industry. All analytical reagents will be Analytical Reagent (AR) grade or better.

9.4. Upon receipt, all standards and reagents should be labeled with the date of receipt, expiration date, and the initials of the person responsible for unpacking and accepting the materials. Care should be taken to note any specific storage requirements such as refrigeration.

9.5. All standards and reagents should be labeled with the date at the time they are initially opened.

9.6. All prepared standards and reagents should be labeled with the standard identification and concentration, solvent, date prepared, expiration date, initials of analyst, and applicable safety information.

9.7. All reference standards, purchased stock, purchased neat solutions, all intermediate solutions, and all working standards used more than one day, must be traceable to their source and method of preparation. Log books are kept documenting the preparation of standards from the "mother" source. Each reference, stock, intermediate and multiple use working standard is assigned a unique number and entered into the appropriate Standards Tracking Log. This unique number should also be applied to the label.

9.8. All records received with standards such as Certificates of Analysis and Material Safety Data Sheets should be retained. All Certificates of Analysis should be labeled with the assigned standard number.

9.9. The assigned number for the source used to prepare the calibration curve, Initial Calibration Verification Standard (ICVS), Continuing Calibration Verification Standard (CCVS), Laboratory Control Standard (LCS), Matrix Spike (MS), Matrix Spike Duplicate (MSD), and surrogates must be referenced on the raw data.

9.10. Where available, the laboratory shall use calibration standards traceable to national standards.

10 References

The following SOPs will provide additional information:

Initial Demonstration of Capability SOP (#106)

Method Detection Limit SOP (#109)

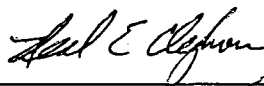
Calibration Curve SOP (#114)

Measurement Traceability and Calibration (#118)

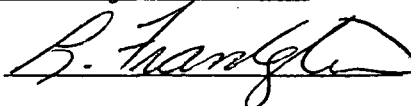
Statistical Control SOP (#112)

11. Approvals

Reviewed for Technical Accuracy by:



Reviewed for Quality Assurance Compliance by:



Implementation Date:

10/6/99

End Use Date:

Lorrie Franklin

From: Neal Cleghorn
Sent: Monday, March 20, 2000 10:53 AM
To: Lorrie Franklin
Subject: Blank Contamination

Lorrie,

Our basis for evaluating method blanks comes from;
"USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" Office of
Emergency and Remedial Response, EPA540/R-94/012, February 1994.

The following is an excerpt from that document...

VOA

E. Action: If the appropriate blanks were not analyzed with the frequency described in Criteria 2, 3, and 4, and 5 then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be noted for TPO action.

Action regarding unsuitable blank results depends on the circumstances and origin of the blank.

Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times (10x) the amount in any blank for the common volatile laboratory contaminants (methylene chloride, acetone, and 2-butanone), or 5 times (5x) the amount for other volatile target compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value.

Specific actions are as follows:

1. If a volatile compound is found in a blank but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfering non-target compounds) at significant concentrations above the CRQL, then this should be noted for TPO action.

2. Any volatile compound detected in the sample (other than the common volatile laboratory contaminants), that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required. For the common volatile laboratory contaminants, the results are qualified by elevating the quantitation limit to the concentration found in the sample when the sample concentration is less than 10 times (10x) the blank concentration.

The reviewer should note that blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" and

"10x" criteria, such that a comparison of the total amount of contamination is actually made.

Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5x" or "10x" rules may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

3. If gross contamination exists (i.e., saturated peaks by GC/MS), all affected compounds in the associated samples should be qualified as unusable (R) due to interference. This should be noted for TPO action if the contamination is suspected of having an effect on the sample results.

4. If inordinate numbers of other target compounds are found at low levels in the blank(s), it may be indicative of a problem and should be noted for TPO action.

5. The same consideration given to the target compounds should also be given to Tentatively Identified Compounds (TICs), which are found in both the sample and associated blank(s). (See VOA Section XII for TIC guidance.)

6. If contaminants are found in the storage blanks, the following action is recommended.

a. The associated method blank data should be reviewed to determine if the contaminant(s) was also present in the method blank. If the analyte was present at a comparable level in the method blank, then the source of the contamination may be in the analytical system and the action recommended for the method blank would apply.

If the analyte was not present in the method blank, then the source of contamination may be in the storage and all associated samples should be considered for possible cross-contamination.

b. If the storage blank contains a volatile TCL compound(s) at a concentration greater than the CRQL, then all positive results for that compound(s) should be qualified with "J". If the concentration level in the blank is significantly high, then positive sample results may require rejection and be qualified with "R". Non-detected volatile target compounds should not require qualification unless the contamination is so high that it interferes with the analysis of the non-detect compounds.

First Environmental Laboratories

Standard Operating Procedure

Title: METHOD 8260B VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY / MASS SPECTROMETRY (GC/MS)

Matrices: wastewater, drinking water, groundwater, soil/sediment, wastes

Regulatory References:

SW-846, 3rd Edition, July 1992 and it's updates, Method 5030, 5035 and 8260B
EPA 600/4-82-057, July 1982, Method 624

Regulatory Limits: NA

Preservation Requirements: Aqueous samples are preserved with 0.5 mL of 1+1 HCL per 40 mL vial. Soil samples are collected and preserved in accordance with method 5035. This method specifies procedures for the collection and preservation of samples for either low level or high level analysis. Samples may be preserved in the field or they may be collected using EnCore™ samplers or equivalent. The laboratory must preserve samples collected using EnCore™ samplers within 48 hours of collection.

Container: 40mL glass vial with teflon-lined septa for aqueous matrices and 4 oz or method 5035 compliant container for solid matrices.

Single Analysis Sample Volume: 5 mL or 1 to 5g.

Holding Time: 14 days for preserved samples (7 days for unpreserved aqueous samples).

(Range) Reporting Limit: 5.0 ug/L – 100 ug/L

Summary of Method:

Method 8260 is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including various air sampling trapping media, ground and surface water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments. The compounds listed in table 1 can be determined by this method.

Analyte	Reporting Limit (RL)	
	Aqueous ug/L	Non-Aqueous ug/kg
Acetone	10.0	10.0
Acetonitrile	100	100
Allyl chloride	5.0	5.0
Benzene	5.0	5.0
Benzyl chloride	100	100
Bromobenzene	5.0	5.0
Bromodichloromethane	5.0	5.0
Bromoform	5.0	5.0
Bromomethane	10.0	10.0
2-Butanone	10.0	10.0
Carbon disulfide	5.0	5.0
Carbon tetrachloride	5.0	5.0
Chlorobenzene	5.0	5.0
Chlorodibromomethane	5.0	5.0
Chloroethane	10.0	10.0
2-Chloroethyl vinyl ether	10.0	10.0
Chloroform	5.0	5.0
Chloromethane	10.0	10.0
1,2-Dibromo-3-chloropropane	100	100
1,2-Dibromoethane	5.0	5.0
Dibromomethane	5.0	5.0
1,2-Dichlorobenzene	5.0	5.0
1,3-Dichlorobenzene	5.0	5.0
1,4-Dichlorobenzene	5.0	5.0
1,4-Dichloro-2-butene	100	100
Dichlorodifluoromethane	5.0	5.0
1,1-Dichloroethane	5.0	5.0
1,2-Dichloroethane	5.0	5.0
1,1-Dichloroethene	5.0	5.0
trans-1,2-Dichloroethene	5.0	5.0
1,2-Dichloropropane	5.0	5.0
cis-1,3-Dichloropropene	5.0	5.0
trans-1,3-Dichloropropene	5.0	5.0
Ethyl benzene	5.0	5.0
Ethyl methacrylate	5.0	5.0
2-Hexanone	10.0	10.0
Iodomethane	10.0	10.0
Methacrylonitrile	100	100
Methyl methacrylate	5.0	50.0
4-Methyl-2-pentanone	10.0	10.0
Methylene chloride	5.0	5.0
Napthalene	10.0	10.0

Analyte	Aqueous ug/L	Non-Aqueous ug/kg
Pentachloroethane	10.0	10.0
Propionitrile	100	100
Styrene	5.0	5.0
1,1,1,2-Tetrachloroethane	5.0	5.0
1,1,2,2-Tetrachloroethane	5.0	5.0
Tetrachloroethene	5.0	5.0
Toluene	5.0	5.0
1,1,1-Trichloroethane	5.0	5.0
1,1,2-Trichloroethane	5.0	5.0
Trichloroethene	5.0	5.0
Trichlorofluoromethane	5.0	5.0
1,2,3-Trichloropropane	5.0	5.0
Vinyl Acetate	10.0	10.0
Vinyl Chloride	10.0	10.0
m&p-Xylene	5.0	5.0
o-Xylene	5.0	5.0

Table 1

There are various techniques by which these compounds may be introduced into the GC/MS system. The more common techniques are purge-and-trap, by Methods 5030 (aqueous samples) and 5035 (solid and waste oil samples). Method 5000 provides more general information on the selection of the appropriate introduction method.

Method 8260 can be used to quantitate most volatile organic compounds that have boiling points below 200 deg C.

The estimated quantitation limit (EQL) of Method 8260 for an individual compound is somewhat instrument dependent and also dependent on the choice of sample preparation/introduction method. Using standard quadrupole instrumentation and the purge-and-trap technique, limits should be approximately 5 ug/kg (wet weight) for soil/sediment samples, 0.5 mg/kg (wet weight) for wastes, and 5 ug/L for ground water. EQLs will be proportionately higher for sample extracts and samples that require dilution or when a reduced sample size is used to avoid saturation of the detector.

This method is restricted to use by, or under the supervision of, analysts experienced in the use of gas chromatograph/mass spectrometers, and skilled in the interpretation of mass spectra and their use as a quantitative tool.

The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method. The analytes are introduced directly to a narrow-bore capillary column for analysis. The column is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced to the gas chromatograph (GC).

Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the

electron impact spectra of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a five-point calibration curve.

The method includes specific calibration and quality control steps that supersede the general requirements provided in Method 8000.

1. Instrumentation / Apparatus / Glassware

Purge-and-trap device for aqueous and solid samples - Described in Method 5030.

Injection port liners (HP Catalog #18740-80200, or equivalent) - modified for direct injection analysis by placing a 1-cm plug of glass wool approximately 50-60 mm down the length of the injection port towards the oven. The analytical column is mounted 1 cm into the liner from the oven side of the injection port, according to manufacturer's specifications.

Gas chromatography/mass spectrometer/data system

Gas chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for splitless injection with appropriate interface for sample introduction device. The system includes all required accessories, including syringes, analytical columns, and gases. The Hewlett Packard 5890 or 6890 meets all the specifications required by method 8260B.

Gas chromatographic column: 25 m x 0.20 mm ID capillary column coated with HP-624, 1.12-um film thickness, or equivalent. (Hewlett Packard part number 19091V-402).

Mass spectrometer - Capable of scanning from 35 to 300 amu every 2 sec or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for 4-Bromofluorobenzene (BFB) which meets all of the criteria in Table 4 when 5-50 ng of the GC/MS tuning standard (BFB) are injected through the GC. To ensure sufficient precision of mass spectral data, the desirable MS scan rate allows acquisition of at least five spectra while a sample component elutes from the GC. The Hewlett Packard model 5972 and 5973 meet all of the requirements of method 8260B.

GC/MS interface - The analytical column is directly coupled into the mass spectrometer ion source.

Data system - A computer system that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program must be interfaced to the mass spectrometer. The computer must have software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIST Mass Spectral Library should also be available. The Hewlett Packard data systems with Enviroquant software meet all of the method requirements.

Microsyringes - 2-, 10-, 25-, 100-, 250-, 500-, and 1,000-uL (gas-tight).

Balance - Top-loading, capable of weighing 0.01 g.

Vials -- 5-, and 2-mL, with mini-nert septa valve for standards storage.

Disposable pipets -- Pasteur, 1- and 10- mL graduated.

Volumetric flasks, Class A - 10-mL, 50-mL and 100-mL, with ground-glass stoppers.

Spatula - Stainless steel.

2. Reagents

Reagent grade inorganic chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all inorganic reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One.

Methanol, CH₃OH -- "Purge and Trap" grade quality or equivalent, demonstrated to be free of analytes.

Hydrochloric acid (1:1 v/v), HCl - Carefully add a measured volume of concentrated HCl to an equal volume of organic-free reagent water.

3. Standards

Stock solutions - Stock solutions are purchased as certified solutions. Store, with minimal headspace and protected from light, at -10°C or less or as recommended by the standard manufacturer. Standards should be returned to the freezer as soon as the analyst has completed mixing or diluting the standards to prevent the evaporation of volatile target compounds.

Frequency of Standard Preparation

Standards for the permanent gases should be monitored frequently by comparison to the initial calibration curve. Fresh standards should be prepared if this check exceeds a 20% drift. Standards for gases usually need to be replaced after one week or as recommended by the standard manufacturer. Dichlorodifluoromethane and dichloromethane will usually be the first compounds to evaporate from the standard and should, therefore, be monitored very closely when standards are held beyond one week.

Standards for the non-gases should be monitored frequently by comparison to the initial calibration. Fresh standards should be prepared if this check exceeds a 20% drift. Standards for non-gases usually need to be replaced after six months or as recommended by the standard manufacturer, unless the

acceptability of the standard can be documented. Standards of reactive compounds such as 2-chloroethyl vinyl ether and styrene may need to be prepared more frequently.

Secondary dilution standards - Using stock standard solutions, prepare secondary dilution standards in methanol containing the compounds of interest, either singly or mixed together. Secondary dilution standards must be stored with minimal headspace and should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them. Store in a vial with no headspace. Replace after one week. Secondary standards for gases should be replaced after one week unless the acceptability of the standard can be documented. When using premixed certified solutions, store according to the manufacturer's documented holding time and storage temperature recommendations. The analyst should also handle and store standards as stated below and return them to the freezer as soon as standard mixing or diluting is completed to prevent the evaporation of volatile target compounds.

Prepare the following VOA calibration solutions: Dilute the indicated volumes of each mixture to 10.0 mLs in a volumetric flask using "Purge and Trap Grade" Methanol.

Solution #1:

Catalog Number	Description	Initial Conc	Volume	Final Conc
RK30006	VOA Calibration Mix #1	5000 ug/mL	100 uL	50 ug/mL
RK30007	VOA Calibration Mix #2	2000 ug/mL	250 uL	50 ug/mL
RK30056	8010A Calibration Mix #2	2000 ug/mL	250 uL	50 ug/mL
RK30057	8010A Calibration Mix #3	2000 ug/mL	250 uL	50 ug/mL
RK30077	8240 Volatiles Mix #1	2000 ug/mL	250 uL	50 ug/mL
RK30078	8240 Volatiles Mix #2	2000 ug/mL	250 uL	50 ug/mL
EPM60034	Acrolein & Acrylonitrile		250 uL	
4-8483	MTBE	2000 ug/mL	250 uL	50 ug/mL
4-0669	Isopropyl benzene	5000 ug/mL	100 uL	50 ug/mL
	Hexane and Heptane		33.0 uL	50 ug/mL

Table 2

Store with minimal headspace in 2mL or 5mL vials with mini-nert valves and septa. Store in the VOA freezer at -18 deg C, separate from samples. This solution should be replaced every 6 months.

The gases mixture, RK30042, is prepared in a separate solution. The gases have a tendency to degrade/evaporate faster than the other compounds and this solution should be replaced weekly.

Solution #2:

Catalog Number	Description	Initial Conc	Volume	Final Conc
RK30042	502.2 Calibration Mix #1	2000 ug/mL	250 uL	50 ug/mL

Table 3

Store with minimal headspace in 2mL or 5mL vials with mini-nert valves and septa. Store in the VOA freezer separate from samples.

update. tw

Internal Standard/System Monitoring Compounds Solution (Surrogate standards) - A stock internal standard/surrogate solution in methanol should be prepared. Each sample undergoing GC/MS analysis must be spiked with 1.0 uL of the surrogate spiking solution prior to analysis.

Prepare the Internal Standard/System Monitoring Compound (SMC) solution by diluting 1000 uL of Restek Catalog #30011, VOA Internal Standard Mix (2500 ug/mL each component) and 1000 uL of Restek Catalog #30004 VOA LM Surrogate Spike Mix (2500 ug/mL each component), to 10.0 mLs in a volumetric flask with "Purge and Trap" Grade methanol.

The solution should be immediately transferred to the Archon autosampler standard vial. The unused portion should be stored with minimal headspace in 2mL or 5mL vials with mini-nert valves and septa. Store in the VOA freezer at -18 deg C, separate from samples. This solution should be replaced every 6 months.

4-Bromofluorobenzene (BFB) standard - A standard solution containing 25 ng/uL of BFB in methanol should be prepared. Prepare the 4-BFB solution by diluting 400 uL of Restek Catalog # 4-BFB Mix (2500 ug/mL) to 10.0 mLs in a volumetric flask with "Purge and Trap" Grade methanol.

Calibration standards -There are two types of calibration standards used for this method: initial calibration standards and calibration verification standards. When using premixed certified solutions, store according to the manufacturer's documented holding time and storage temperature recommendations.

Initial calibration standards should be prepared at a minimum of five different concentrations from the secondary dilution of stock standards or from a premixed certified solution. Prepare these solutions in organic-free reagent water. At least one of the calibration standards should correspond to a sample concentration at or below that necessary to meet the data quality objectives of the project. The remaining standards should correspond to the range of concentrations found in typical samples but should not exceed the working range of the GC/MS system. Initial calibration standards should be mixed from fresh stock standards and dilution standards when generating an initial calibration curve.

For non-aqueous calibrations, prepare the 5-point calibration using the following amounts of calibration solution #1 and #2, as described above, added to 5.0mLs of DI water: For aqueous calibrations, prepare the 5-point calibration using the following amounts added to 50.0mLs of DI water:

Std Conc:	5.0 ppB	10.0 ppB	20.0 ppB	50.0 ppB	100 ppB	200 ppB
Non-Aqueous	0.5 uL	1.0 uL	2.0 uL	5.0 uL	10.0 uL	20.0 uL
Aqueous	5.0	10.0	20.0	50.0	100	200

Table 4

Analyze the initial calibration curve according to the analysis procedure in Section 4.

Calibration verification standards should be prepared at a concentration of 50.0 ug/L. Prepare these solutions in organic-free reagent water.

It is the intent of EPA that all target analytes for a particular analysis be included in the initial calibration and calibration verification standard(s). These target analytes may not include the entire list of analytes for which the method has been demonstrated. However, the laboratory shall not report a quantitative result for a target analyte that was not included in the calibration standard(s).

The calibration standards must also contain the internal standards chosen for the analysis.

Matrix spiking and laboratory control sample (LCS) standards - Matrix spiking standards should be prepared from volatile organic compounds which are representative of the compounds being investigated. At a minimum, the matrix spike should include 1,1-dichloroethene, trichloroethene, chlorobenzene, toluene, and benzene. The matrix spiking solution should contain compounds that are expected to be found in the types of samples to be analyzed.

Prepare the matrix spike solution by diluting 100 uL of Restek catalog #30005 VOA Matrix Spike Mix (2500 ug/mL each component) to 10.0 mLs in a volumetric flask with "Purge and Trap" Grade methanol.

Store with minimal headspace in 2mL or 5mL vials with mini-nert valves and septa. Store in the VOA freezer at -18 deg C, separate from samples. This solution should be replaced every 6 months.

Great care must be taken to maintain the integrity of all standard solutions. It is recommended all standards in methanol be stored at -10 deg C or less, in amber bottles with PTFE-lined screw-caps.

4. Analytical Procedures

4.1. Interferences

Major contaminant sources are volatile materials in the laboratory and impurities in the inert purging gas and in the sorbent trap. The use of non-polytetrafluoroethylene (PTFE) thread sealants, plastic tubing, or flow controllers with rubber components should be avoided, since such materials out-gas organic compounds which will be concentrated in the trap during the purge operation. Analyses of calibration and reagent blanks provide information about the presence of contaminants. When potential interfering peaks are noted in blanks, the analyst should change the purge gas source and regenerate the molecular sieve purge gas filter. Subtracting blank values from sample results is not permitted. If reporting values without correcting for the blank results in what the laboratory feels is a false positive result for a sample, the laboratory should fully explain this in text accompanying the uncorrected data.

Contamination may occur when a sample containing low concentrations of volatile organic compounds is analyzed immediately after a sample containing high concentrations of volatile organic compounds. A technique to prevent this problem is to rinse the purging apparatus and sample syringes with two portions of organic-free reagent water between samples. After the analysis of a sample containing high concentrations of volatile organic compounds, one or more blanks should be analyzed to check for cross-contamination. Alternatively, if the sample immediately following the high concentration sample does not contain the volatile organic compounds present in the high level sample, freedom from contamination has been established.

For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds, or high concentrations of compounds being determined, it may be necessary to wash the purging device with a soap solution, rinse it with organic-free reagent water, and then dry the purging device in an oven at 105 deg C. In extreme situations, the entire purge-and-trap device may require dismantling and cleaning. Screening of the samples prior to purge-and-trap GC/MS analysis is highly recommended to prevent contamination of the system.

Many analytes exhibit low purging efficiencies from a 25-mL sample. This often results in significant amounts of these analytes remaining in the sample purge vessel after analysis. After removal of the sample aliquot that was purged, and rinsing the purge vessel three times with organic-free water, the empty vessel should be subjected to a heated purge cycle prior to the analysis of another sample in the same purge vessel. This will reduce sample-to-sample carryover.

Special precautions must be taken to analyze for methylene chloride. The analytical and sample storage area should be isolated from all atmospheric sources of methylene chloride. Otherwise, random background levels will result. Since methylene chloride will permeate through PTFE tubing, all gas chromatography carrier gas lines and purge gas plumbing should be constructed from stainless steel or copper tubing. Laboratory clothing worn by the analyst should be clean, since clothing previously exposed to methylene chloride fumes during liquid/liquid extraction procedures can contribute to sample contamination.

Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample container into the sample during shipment and storage. A trip blank prepared from organic-free reagent water and carried through the sampling, handling, and storage protocols can serve as a check on such contamination.

Direct injection - Some contamination may be eliminated by baking out the column between analyses. Changing the injector liner will reduce the potential for cross-contamination. A portion of the analytical column may need to be removed in the case of extreme contamination. The use of direct injection will result in the need for more frequent instrument maintenance.

4.2. Sample Preservation

See the introductory material to SW-846 Chapter 4, Organic Analytes, Sec. 4.1.

Volatile samples are stored in a refrigerator dedicated to the storage of volatile samples away from all standards, reagents, food and other contaminating sources.

4.3 Determinative Procedure

Purge-and-trap - This includes purge-and-trap for aqueous samples (Method 5030) and purge-and-trap for solid samples (Method 5035). Method 5035 also provides techniques for extraction of high concentration solid and oily waste samples by methanol (and other water-miscible solvents) with subsequent purge-and-trap from an aqueous matrix using Method 5030.

Traditionally, the purge-and-trap of aqueous samples is performed at ambient temperature, while purging of soil/solid samples is performed at 40°C, to improve purging efficiency.

GC/MS Instrument Conditions (Split Injection)

In this technique the desorb line from the Tekmar unit is connected to the GC injection port. The sample is introduced to the narrow bore column using the split injection technique. (These parameters should be programmed and saved into a Hewlett Packard Enviroquant method file named: *_8260S.M where "*" is the instrument ID letter.) A separate method file should be kept for aqueous and non-aqueous sample analyses. The Hewlett Packard software stores calibration information as well as the analytical parameters in the Method file. Typically, the method name ending with an "S" will be the non-aqueous method file, and the method name ending with a "W" will be the aqueous method file.

Column	HP-624 25meter
Column ID/Thickness	0.2mm ID 1.12um
Interface	Cap Direct Split Inj.
GC Type	HP5890 Series II/Plus
Mass Spectrometer	HP5972A
Tune	BFB Tune + 300v
Scan Range	35-260 amu
Sampling #	3
Threshold	100
Carrier Gas	Helium
Vacuum Comp.	On
Pressure	16psi @ 35 deg C
Constant Flow Mode	1.0 mL/min
Split Flow	25 ml/min
Split Ratio	25:1
Inj. B Temp	220 C
Detector B Temp	280 C
Initial Temp	35 C
Initial Time	4 minutes
Rate(1)	7.00 C/min
Final Temp(1)	120 C
Final Time(1)	0 min
Rate(2)	25.0 C/min
Final Temp(2)	230 C
Final Time(2)	1.50 min
Total GC run time	22.04 min
Purge B	On (during entire run)

Table 5

BFB. Each GC/MS system must be hardware-tuned to meet the criteria in Table 6 for a 5-50 ng injection or purging of 4-bromofluorobenzene (2-uL injection of the BFB standard). Analyses must not begin until these criteria are met.

BFB (4-BROMOFLUOROBENZENE) MASS INTENSITY CRITERIA

m/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

Table 6

In the absence of specific recommendations on how to acquire the mass spectrum of BFB from the instrument manufacturer, the following approach has been shown to be useful: The mass spectrum of BFB may be acquired in the following manner. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan no more than 20 scans prior to the elution of BFB. Do not background subtract part of the BFB peak. Alternatively, the analyst may use other documented approaches suggested by the instrument manufacturer.

Use the BFB mass intensity criteria in Table 6 as tuning acceptance criteria. Alternatively, other documented tuning criteria may be used (e.g., CLP, Method 524.2, or manufacturer's instructions), provided that method performance is not adversely affected.

NOTE: All subsequent standards, samples, MS/MSDs, LCSs, and blanks associated with a BFB analysis must use identical mass spectrometer instrument conditions.

Calibration Curve. A different calibration curve is necessary for each method because of the differences in conditions and equipment. A set of at least five different calibration standards is necessary. Calibration must be performed using the sample introduction technique that will be used for samples. For Method 5030, the purging efficiency for 5 mL of water is greater than for 25 mL. Therefore, develop the standard curve with whichever volume of sample that will be analyzed.

To prepare a calibration standard, add an appropriate volume of a secondary dilution standard solution to an aliquot of organic-free reagent water in a volumetric flask. Use a microsyringe and rapidly inject the alcoholic standard into the expanded area of the filled volumetric flask. Remove the needle as quickly as possible after injection. Mix by inverting the flask three times only. Discard the contents contained in the neck of the flask. Aqueous standards are not stable and should be prepared daily. For soil analysis, prepare the standard in a 5.0 mL gas tight syringe. Then transfer the contents to a 40 mL vial. For aqueous samples, prepare the standards in a 50 mL volumetric flask. Then transfer the contents to a 40 mL vial.

Proceed with the analysis of the calibration standards following the procedure in method 5030 or 5035.

Update the initial calibration in the Enviroquant method identification file. This will automatically update the response factors that will be used in the quantification of target compounds.

System performance check compounds (SPCCs). A system performance check should be made before this calibration curve is used. Five compounds (the System Performance Check Compounds, or SPCCs) are checked for a minimum average response factor. These compounds are chloromethane; 1,1-dichloroethane; bromoform; chlorobenzene; and 1,1,2,2-tetrachloroethane. These compounds are used to check compound instability and to check for degradation caused by contaminated lines or active sites in the system. Example problems include:

Chloromethane is the most likely compound to be lost if the purge flow is too fast.

Bromoform is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response. Response of the quantitation ion (m/z 173) is directly affected by the tuning of BFB at ions m/z 174/176. Increasing the m/z 174/176 ratio relative to m/z 95 may improve bromoform response.

Tetrachloroethane and 1,1-dichloroethane are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

The minimum mean response factors for the volatile SPCCs are as follows:

Chloromethane	0.10
1,1-Dichloroethane	0.10
Bromoform	0.10
Chlorobenzene	0.30
1,1,2,2-Tetrachloroethane	0.30

Calibration check compounds (CCCs). The purpose of the CCCs are to evaluate the calibration from the standpoint of the integrity of the system. High variability for these compounds may be indicative of system leaks or reactive sites on the column. Meeting the CCC criteria is not a substitute for successful calibration of the target analytes using one of the approaches described in Sec. 7.0 of Method 8000.

The RSD for each individual Calibration Check Compound (CCC) must be equal or less than 30%. If the CCCs are not included in the list of analytes for a project, and therefore not included in the calibration standards, refer to Sec. 7.0 of Method 8000. The CCCs are:

1,1-Dichloroethene	Toluene
Chloroform	Ethylbenzene
1,2-Dichloropropane	Vinyl chloride

If an RSD of greater than 30% is measured for any CCC, then corrective action to eliminate a system leak and/or column reactive sites is necessary before reattempting calibration.

Evaluation of retention times. The relative retention times of each target analyte in each calibration standard should agree within 0.06 relative retention time units. Late-eluting compounds usually have much better agreement.

Linearity of target analytes. If the RSD of any target analyte is 15% or less, then the response factor is assumed to be constant over the calibration range, and the average response factor may be used for quantitation. If the RSD of any target analyte is greater than 15%, a linear regression or quadratic regression may be used for quantitation.

GC/MS calibration verification - Calibration verification consists of three steps that are performed at the beginning of each 12-hour analytical shift.

1. Prior to the analysis of samples or calibration standards, inject or introduce 5-50 ng of the 4-bromofluorobenzene standard into the GC/MS system. The resultant mass spectra for the BFB must meet the criteria given in Table 4 before sample analysis begins. These criteria must be demonstrated each 12-hour shift during which samples are analyzed.
2. The initial calibration curve for each compound of interest should be verified once every 12 hours prior to sample analysis, using the introduction technique used for samples. This is accomplished by analyzing a 50 ug/L calibration standard. The results from the calibration standard analysis should meet the verification acceptance criteria provided above. A system performance check must be made during every 12-hour analytical shift. This verification includes evaluation of the SPCC and CCC compounds. Each SPCC compound in the calibration verification standard must meet its minimum response factor. This is the same check that is applied during the initial calibration. If the percent difference or drift for each CCC is less than or equal to 20%, the initial calibration is assumed to be valid. If the criterion is not met (i.e., greater than 20% difference or drift), for any one CCC, then corrective action must be taken prior to the analysis of samples. If the CCC's are not included in the list of analytes for a project, and therefore not included in the calibration standards, then all analytes must meet the 20% difference or drift criterion.
3. A method blank should be analyzed after the calibration standard, or at any other time during the analytical shift, to ensure that the total system (introduction device, transfer lines and GC/MS system) is free of contaminants. If the method blank indicates contamination, then it may be appropriate to analyze a solvent blank to demonstrate that the contamination is not a result of carryover from standards or samples

Internal standard retention time. The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

Internal standard response. If the EICP area for any of the internal standards in the calibration verification standard changes by a factor of two (-50% to + 100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

4.4 Sample Preparation

All samples and standard solutions must be allowed to warm to ambient temperature before analysis. Set up the introduction device as outlined in the method of choice.

The process of taking an aliquot destroys the validity of remaining volume of an aqueous sample for future analysis.

Aqueous Samples. With the Varian Archon autosampler, the 40 mL sample vial that was collected in the field is placed directly on the autosampler tray. The autosampler is then instructed to withdraw a 5 mL aliquot for analysis. The internal standard and surrogate solution is automatically added by the autosampler.

The following procedure may be used to dilute aqueous samples for analysis of volatiles. All steps must be performed without delays, until the diluted sample is in the 40 mL vial.

- 1 Dilutions may be made in volumetric flasks (50- to 100-mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilution steps may be necessary for extremely large dilutions.
- 2 Calculate the approximate volume of organic-free reagent water to be added to the volumetric flask, and add slightly less than this quantity of organic-free reagent water to the flask.
- 3 Inject the appropriate volume of the original sample from the syringe into the flask. Dilute the sample to the mark with organic-free reagent water. Cap the flask, invert, three times. Repeat above procedure for additional dilutions.
- 4 Fill a 40-mL vial with the diluted sample, making sure there is no headspace when the cap is applied.

Add 100 uL of the matrix spike solution to a 50-mL aliquot of the sample chosen for spiking. Disregarding any dilutions, this is equivalent to a concentration of 50 ug/L of each matrix spike standard.

Follow the same procedure in preparing the laboratory control sample (LCS), except the spike is added to a clean matrix.

Non-Aqueous Samples. With the Varian Archon autosampler, the 40 mL sample vial that was collected in the field (using method 5035) is placed directly on the autosampler tray. The autosampler is then instructed to add 5 mLs of lab water to the vial along with the internal standard and surrogate solution. The Archon will then purge the soil sample within the 40 mL vial, while heating the sample to 40 deg C and activating the stir bar motor.

The following procedure may be used to dilute non-aqueous samples for analysis of volatiles. All steps must be performed without delays, until the diluted sample is in the 40 mL vial.

- 1 Weigh the methanol-preserved vial on the top pan balance. Determine the weight of the sample by subtracting the tare weight. If no methanol-preserved vial has been

collected in the field, weigh approximately 10 grams of sample into a 40 mL vial. Add 10 mLs of methanol, agitate for 2 minutes and then allow the extract to settle.

2 Withdraw a 1.0 mL aliquot of the methanol extract and dilute it to 50 mLs in a volumetric flask. Cap the flask, invert, three times. Repeat above procedure for additional dilutions.

3 Fill a 40-mL vial with the diluted sample, making sure there is no headspace when the cap is applied. Analyze this dilution using the same procedure as an aqueous sample.

Add 10 uL of the matrix spike solution to 5.0-mL organic-free water and add to a pre-weighed aliquot of the sample chosen for spiking. Disregarding any dilutions, this is equivalent to a concentration of 50 ug/kg of each matrix spike standard.

Follow the same procedure in preparing the laboratory control sample (LCS), except the spike is added to a clean matrix.

NOTE: It may be a useful diagnostic tool to monitor internal standard retention times and responses (area counts) in all samples, spikes, blanks, and standards to effectively check drifting method performance, poor injection execution, and anticipate the need for system inspection and/or maintenance.

If the initial analysis of the sample or a dilution of the sample has a concentration of any analyte that exceeds the initial calibration range, the sample must be reanalyzed at a higher dilution. Typically, this is 200 ug/L for most compounds.

4.5 Qualitative analysis

The qualitative identification of each compound determined by this method is based on retention time, and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met.

The Enviroquant software method should be set-up to meet the specifications outlined in method 8260B, section 7.6.1.

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted.

4.6 Quantitative analysis

Sample calculations for volatile analyses are made according to the following procedure:

The target compound concentrations are calculated by the internal standard method. The relative response factor (RRF) from the multi-point calibration is used to calculate the concentration in the sample.

$$\text{Sample Concentration} = \frac{(\text{Area of Compound}) (\text{Amt IS}) (\text{Final Volume})}{(\text{Area IS}) (\text{RRF}) (\text{Initial Volume or Weight})}$$

The automatic Hewlett Packard quantitation algorithm will report the calculation above for water samples on the report summary page. The soil sample concentration must be calculated manually using the following equation:

$$\text{Sample Concentration} = \frac{(\text{Reported Concentration}) (5)}{(\text{Weight of sample purged}) (\% \text{ Total Solids})}$$

(Note: The multiplier "5" in the numerator is to convert the concentration, which is calculated as micrograms per Liter, to total nanograms.)

High Concentration (Medium Level) Soil Calculation:

Sample calculations for volatile soil analyses are made according to the following procedure:

The target compound concentrations are calculated by the internal standard method. The relative response factor (RRF) from the multi-point calibration is used to calculate the concentration in the sample.

$$\text{Sample Concentration} = \frac{(\text{Area of Compound}) (\text{Amt IS}) (\text{Volume of total extract in uL})}{(\text{Area IS}) (\text{RRF}) (\text{Volume of purged extract})(\text{Initial Weight})}$$

The automatic Hewlett Packard quantitation algorithm will report the calculation above for water samples on the report summary page. The soil sample concentration must be calculated manually using the following equation:

$$\text{Sample Concentration} = \frac{(\text{Reported Concentration, ug/L}) (5) (\text{Volume of total extract in uL})}{(\text{Volume extract added for purging, uL})(\text{Sample Weight})(\% \text{TS})}$$

4.7 Expression of Results for Solid Samples

Soils should be expressed on a dry weight basis as ug/kg. The exception would be a solid material submitted for RCRA compliance, in which case the results should be expressed on a wet weight basis.

5. Quality Control

Quality Control Indicator (QCI)	Frequency	Control Limit (Interim)	Control Limit (Statistical)
System Tuning (BFB)	The start of every 12-hour sequence	Table 6 above	NA
Calibration Curve	Referenced - performed at least annually	ccc compounds must be <30% RSD SPCCs >RRF	NA
Initial Calibration Verification	Immediately following the curve	± 10% or within stated limits	As supplied by manufacturer
Method Blank	Every 12 hour sequence following the CCVS	Less than the reporting limit	NA
Continuing Calibration Standard (CCVS) – 50 ug/L	Every 12-hour sequence	ccc compounds must be <20%	NA
Laboratory Control Standard (LCS) – 50 ug/L	Per batch, where a batch is defined as daily or every 20 samples - whichever is less	± 20%	3 standard deviations for the control limit and 2 standard deviations for the warning limit*
Matrix Spike / Matrix Spike Duplicate (MS/MSD) – 50 ug/L	Per batch, where a batch is defined as daily or every 20 samples - whichever is less	± 25%	3 standard deviations for the control limit and 2 standard deviation for the warning limit
Surrogate Recoveries	Every Sample	Per method	3 standard deviations for the control limit and 2 standard deviation for the warning limit
Internal Standard Areas	Every Sample	Areas must be +/- 50% of CCVS	NA
* A control chart is required for both the MS/MSD or the LCS			

The experience of the analyst performing GC/MS analyses is invaluable to the success of the methods. Each day that analysis is performed, the calibration verification standard should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: Do the peaks look normal? Is the response obtained comparable to the response from previous calibrations? Careful examination of the standard chromatogram can indicate whether the column is still performing acceptably, the injector is leaking, the injector septum needs replacing, etc. If any changes are made to the system (e.g., the column changed), recalibration of the system must take place.

6. Notes

6.1. Tips and Hints

See text of SOP

7. Definitions

Where appropriate, definitions have been provided in this SOP. If additional clarification is required, refer to the SOP titled, Analytical Definitions & Acronyms.

8. Safety

The toxicity or carcinogenicity of each reagent used in this method have not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable. Material Safety Data Sheets (MSDS) are available for review. All reagents should be appropriately labeled. Always wear safety glasses for eye protection, protective clothing and observe proper mixing when working with chemicals and potentially hazardous samples. Additional information can be found in the laboratories' Chemical Hygiene Plan.

9. Pollution Prevention

Pollution prevention is defined in EPA documents as any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. First Environmental Laboratories, Inc. uses reduced volume procedures, where feasible, in order to comply with EPA guidance. The laboratory continuously assesses new technology that assists in the reduction or elimination of waste.

10. Waste Management

The analysis of samples inevitably produces various wastes. When possible, First Environmental Laboratories, Inc. minimizes all releases from hoods and bench operations. Wastes, which

cannot be neutralized or made innocuous, are collected and disposed of in an appropriate manner. Additional information can be found in the laboratories' Chemical Hygiene Plan.

11. Approvals

Reviewed for Technical Accuracy by: Paul E. Cleghorn

Reviewed for Quality Assurance Compliance by: P. Frankler

Implementation Date: 1/25/99

End Use Date: _____

Method Detection Limit (MDL) Study Final Report

Laboratory:	First Environmental Laboratories, Inc.		
Method / Revision (all):	SW-846 Method 8260B and EPA 600/482-057 Method 624		
Analyte or Analyte Group:	Volatile Soils		
Preparation Analyst:	Not Applicable		
Instrument Analyst:	John Bychowski		
Date of Analysis:	04/11/02		
Instrument ID:	GC/MS "A" with Archon Autosampler		
Instrument Conditions:	Standard		
Est. Detection Limit:	5.0 ug/L		

Calib. Standards Source:	Supelco #5377, #5378	Date Prepared:	02/22/02	01/21/99
Spiking Solution Source:	Supelco #5418, #5419	Date Prepared:	03/13/02	01/12/99
Spiking Concentration:	5.0 ug/kg	Units:	ug/kg	

A minimum of seven replicates was used to perform the MDL study? ☒ yes ☐ no

Were all replicates values used in determining the MDL? ☒ yes ☐ no

If no, submit documentation verifying that the laboratory excluded values which it determined are outliers by using a statistical outlier test.

Has the laboratory established criteria for accepting replicate percent recovery? ☒ yes ☐ no

If yes, the acceptance criteria can be found in MDL SOP page 6. ($\pm 50\%$ or per method)

If yes, this MDL study has met the laboratory's criteria for acceptable replicate percent recovery? ☐ yes ☒ no

The calculated MDL is greater than "0"? ☒ yes ☐ no

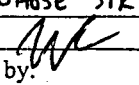
The calculated MDL is greater than 1/10 the MDL spiking concentration? ☒ yes ☐ no

The MDL spiking concentration is greater than the calculated MDL? ☒ yes ☐ no

For drinking water laboratory accreditation, the laboratory has achieved a MDL equal to or less than those specified in Section 186 Appendix A? 186.160(c) ☐ yes ☐ no

Only MDL studies meeting the requirements set forth in Section 186.160 will be deemed acceptable.

Comments: *MDL STUDY REPEATED AT 2.0 ug/kg SPIKE LEVEL FOR CPDS WHOSE SPIKE LEVEL > 10x MDL VALUE. (16 CPDS)

Approved by: 

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8	#9
	a65171.d	a65172.d	a65173.d	a65174.d	a65175.d	a65176.d	a65177.d	a65178.d	
Dichlorodifluoromethane	3.32	3.93	4.05	4.40	2.95	3.25	3.69	3.79	
Chloromethane	4.25	4.43	4.74	4.98	3.91	3.96	4.31	4.50	
Vinyl Chloride	3.90	4.35	4.80	5.03	3.54	3.74	4.15	4.33	
Bromomethane	6.77	7.02	7.34	7.64	6.72	6.58	7.04	7.02	
Chloroethane	4.79	5.04	5.54	5.69	4.54	4.90	5.31	5.31	
Trichlorofluoromethane	4.23	4.93	5.13	5.53	3.80	4.18	4.60	4.99	
Ethyl ether	4.81	5.17	5.03	5.26	5.39	5.03	5.66	5.80	
Acrolein	37.65	35.17	38.74	39.38	32.86	43.94	38.36	33.52	
Acetone	8.00	8.62	8.80	8.52	8.07	8.30	8.69	9.99	
1,1-Dichloroethene	4.36	4.91	5.20	5.87	4.26	4.37	5.02	5.44	
Iodomethane	4.12	4.46	4.42	4.71	3.94	4.25	4.41	4.52	
Allyl chloride	4.82	5.11	5.44	5.55	4.82	5.00	5.49	5.66	
Methylene chloride	6.18	6.45	5.90	6.50	5.63	5.68	5.89	6.74	
Acrylonitrile	24.56	28.26	26.92	26.24	26.86	26.19	28.07	28.56	
Carbon disulfide	4.82	5.47	5.74	6.15	4.55	4.89	5.30	5.55	
trans-1,2-Dichloroethene	4.35	4.95	4.94	5.24	4.06	4.36	4.91	4.94	
cis-1,2-Dichloroethene	4.44	4.73	4.81	4.92	4.42	4.46	4.79	4.83	
Methyl-t-butyl ether (MTBE)	5.04	5.52	5.47	5.42	5.47	5.51	5.79	5.96	
n-Hexane	4.66	5.27	5.61	6.07	4.14	4.41	5.09	5.42	
Vinyl Acetate	4.78	5.36	5.16	5.39	5.35	5.48	5.56	5.68	
1,1-Dichloroethane	4.48	4.97	5.20	5.46	4.71	4.97	5.29	5.37	
2,2-Dichloropropane	4.03	4.50	4.67	4.81	3.78	3.90	4.37	4.37	
2-Butanone (MEK)	4.47	4.06	3.59	3.74	3.73	3.61	4.51	3.61	
Propionitrile	4.77	4.24	4.71	4.72	4.72	4.14	4.64	4.95	
Methyl acrylate	4.61	5.38	4.90	4.97	4.87	5.04	5.11	5.21	
Bromochloromethane	4.55	4.59	4.65	4.78	4.38	4.48	4.50	4.66	
Methacrylonitrile	5.92	6.80	6.13	6.51	6.25	6.24	6.97	7.14	
Tetrahydrofuran (THF)	7.82	8.68	8.07	8.02	8.86	8.17	8.72	9.74	
Chloroform	7.13	7.59	7.74	8.03	7.54	7.58	8.08	8.07	
Dibromofluoromethane	52.85	54.54	54.07	54.66	55.84	55.55	56.08	57.43	
1,1,1-Trichloroethane	4.14	4.76	4.78	5.15	3.98	4.15	4.54	4.74	
Butyl chloride (1-chlorobutane)	5.11	5.62	5.77	6.30	5.04	5.20	5.72	5.86	
Carbon tetrachloride	4.10	4.44	4.64	5.07	3.71	3.67	4.16	4.23	
1,1-Dichloropropene	4.53	5.03	5.12	5.70	4.24	4.35	4.95	4.92	
1,2-Dichloroethane	4.81	5.14	5.15	5.49	5.19	5.23	5.59	5.74	

Method Detection Limit (MDL) Study Final Report

Note: CL = confidence limit

Check T value @ 99% Confidence Level for No. of replicates in study.

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Dichlorodifluoromethane	3.67	73.5	5	0.47	3.00	1.42	ug/L	2.73	0.98	9.49
Chloromethane	4.39	87.7	5	0.36	3.00	1.09	ug/L	2.09	0.75	7.27
Vinyl Chloride	4.23	84.6	5	0.51	3.00	1.53	ug/L	2.94	1.06	10.20
Bromomethane	7.02	140.3	5	0.35	3.00	1.03	ug/L	1.99	0.71	6.90
Chloroethane	5.14	102.8	5	0.39	3.00	1.17	ug/L	2.25	0.81	7.82
Trichlorofluoromethane	4.67	93.5	5	0.58	3.00	1.72	ug/L	3.31	1.19	11.51
Ethyl ether	5.27	105.4	5	0.33	3.00	1.00	ug/L	1.93	0.69	6.69
Acrolein	37.45	149.8	25	3.59	3.00	10.76	ug/L	20.65	7.42	14.35
Acetone	8.62	172.5	5	0.62	3.00	1.87	ug/L	3.58	1.29	12.45
1,1-Dichloroethene	4.93	98.6	5	0.57	3.00	1.72	ug/L	3.31	1.19	11.50
Iodomethane	4.35	87.1	5	0.24	3.00	0.73	ug/L	1.39	0.50	4.84
Allyl chloride	5.24	104.7	5	0.34	3.00	1.01	ug/L	1.95	0.70	6.77
Methylene chloride	6.12	122.4	5	0.41	3.00	1.23	ug/L	2.36	0.85	8.20
Acrylonitrile	26.96	107.8	25	1.33	3.00	3.98	ug/L	7.65	2.75	5.32
Carbon disulfide	5.31	106.2	5	0.53	3.00	1.59	ug/L	3.05	1.10	10.60
trans-1,2-Dichloroethene	4.72	94.4	5	0.41	3.00	1.22	ug/L	2.34	0.84	8.14
cis-1,2-Dichloroethene	4.68	93.5	5	0.20	3.00	0.60	ug/L	1.16	0.42	4.04
Methyl-t-butyl ether (MTBE)	5.52	110.5	5	0.27	3.00	0.81	ug/L	1.56	0.56	5.41
n-Hexane	5.08	101.7	5	0.65	3.00	1.94	ug/L	3.72	1.34	12.92
Vinyl Acetate	5.35	106.9	5	0.28	3.00	0.83	ug/L	1.59	0.57	5.52
1,1-Dichloroethane	5.06	101.1	5	0.34	3.00	1.02	ug/L	1.95	0.70	6.78
2,2-Dichloropropane	4.30	86.1	5	0.37	3.00	1.10	ug/L	2.12	0.76	7.37
2-Butanone (MEK)	3.92	78.3	5	0.39	3.00	1.16	ug/L	2.22	0.80	7.71
Propionitrile	4.61	92.2	5	0.28	3.00	0.83	ug/L	1.59	0.57	5.52
Methyl acrylate	5.01	100.2	5	0.23	3.00	0.70	ug/L	1.34	0.48	4.67
Bromochloromethane	4.57	91.5	5	0.12	3.00	0.37	ug/L	0.72	0.26	2.49
Methacrylonitrile	6.50	129.9	5	0.43	3.00	1.30	ug/L	2.50	0.90	8.70
Tetrahydrofuran (THF)	8.51	170.2	5	0.62	3.00	1.87	ug/L	3.60	1.29	12.50
Chloroform	7.72	154.4	5	0.33	3.00	0.99	ug/L	1.90	0.68	6.61
Dibromofluoromethane	55.13	110.3	50	1.40	3.00	4.20	ug/L	8.07	2.90	2.80
1,1,1-Trichloroethane	4.53	90.6	5	0.40	3.00	1.21	ug/L	2.33	0.84	8.08
Butyl chloride (1-chlorobutane)	5.58	111.6	5	0.43	3.00	1.30	ug/L	2.49	0.90	8.66
Carbon tetrachloride	4.25	85.1	5	0.47	3.00	1.40	ug/L	2.68	0.96	9.32
1,1-Dichloropropene	4.86	97.1	5	0.47	3.00	1.42	ug/L	2.72	0.98	9.46
1,2-Dichloroethane	5.29	105.9	5	0.30	3.00	0.89	ug/L	1.71	0.61	5.95

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times MDL	MDL Spk Conc is >MDL
Dichlorodifluoromethane	Y	3.5	Y	Y
Chloromethane	Y	4.6	Y	Y
Vinyl Chloride	Y	3.3	Y	Y
Bromomethane	Y	4.8	Y	Y
Chloroethane	Y	4.3	Y	Y
Trichlorofluoromethane	Y	2.9	Y	Y
Ethyl ether	Y	5.0	Y	Y
Acrolein	Y	2.3	Y	Y
Acetone	N	2.7	Y	Y
1,1-Dichloroethene	Y	2.9	Y	Y
Iodomethane	Y	6.9	Y	Y
Allyl chloride	Y	4.9	Y	Y
Methylene chloride	Y	4.1	Y	Y
Acrylonitrile	Y	6.3	Y	Y
Carbon disulfide	Y	3.1	Y	Y
trans-1,2-Dichloroethene	Y	4.1	Y	Y
cis-1,2-Dichloroethene	Y	8.3	Y	Y
Methyl-t-butyl ether (MTBE)	Y	6.2	Y	Y
n-Hexane	Y	2.6	Y	Y
Vinyl Acetate	Y	6.0	Y	Y
1,1-Dichloroethane	Y	4.9	Y	Y
2,2-Dichloropropane	Y	4.5	Y	Y
2-Butanone (MEK)	Y	4.3	Y	Y
Propionitrile	Y	6.0	Y	Y
Methyl acrylate	Y	7.1	Y	Y
Bromochloromethane	Y	13.4	N	Y
Methacrylonitrile	Y	3.8	Y	Y
Tetrahydrofuran (THF)	N	2.7	Y	Y
Chloroform	N	5.0	Y	Y
Dibromofluoromethane	Y	11.9	N	Y
1,1,1-Trichloroethane	Y	4.1	Y	Y
Butyl chloride (1-chlorobutane)	Y	3.9	Y	Y
Carbon tetrachloride	Y	3.6	Y	Y
1,1-Dichloropropene	Y	3.5	Y	Y
1,2-Dichloroethane	Y	5.6	Y	Y

Method Detection Limit (MDL) Study Final Report

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Compound ID:	a65171.d	a65172.d	a65173.d	a65174.d	a65175.d	a65176.d	a65177.d	a65178.d	
Benzene	4.48	4.84	4.98	5.27	4.44	4.68	4.73	4.88	
n-Heptane	4.21	4.82	5.09	5.77	3.62	4.07	4.52	4.83	
Trichloroethene	4.10	4.50	4.55	4.94	3.83	4.14	4.36	4.35	
Methyl methacrylate	4.15	4.46	4.39	4.43	4.04	4.14	4.41	4.49	
1,2-Dichloropropane	4.50	4.92	5.01	5.36	4.76	5.11	5.11	5.20	
Bromodichloromethane	4.61	4.83	4.95	5.24	4.76	4.88	5.04	5.19	
Dibromomethane	4.73	4.90	4.86	5.01	4.62	4.75	5.00	5.13	
2-Nitropropane	3.44	3.69	3.36	3.76	3.44	3.35	3.84	4.07	
2-Chloroethyl vinyl ether	3.94	3.99	3.99	3.90	3.90	4.06	3.87	4.29	
cis-1,3-Dichloropropene	4.39	4.54	4.81	4.83	4.40	4.58	4.66	4.79	
4-Methyl-2-pentanone	4.01	4.63	4.63	4.69	4.67	4.46	4.69	4.85	
Toluene	4.24	4.51	4.68	4.82	4.06	4.17	4.33	4.57	
trans-1,3-Dichloropropene	4.28	4.46	4.52	4.61	4.41	4.45	4.46	4.50	
1,1,2-Trichloroethane	4.82	4.95	4.87	5.13	4.75	4.84	5.14	5.14	
d8-Toluene	50.41	50.91	50.65	52.19	51.71	52.37	52.23	53.18	
1,2-Dibromoethane	4.35	4.55	4.34	4.35	4.48	4.40	4.48	4.47	
1,4-Dichloro-2-butene	4.04	4.59	4.49	4.71	4.16	4.49	4.31	4.78	
Ethyl methacrylate	4.10	4.27	4.26	4.29	4.19	4.12	4.15	4.35	
2-Hexanone	4.32	4.56	4.43	4.46	4.37	4.22	4.36	4.55	
Tetrachloroethene	3.98	4.08	4.17	4.52	3.37	3.53	3.71	4.41	
1,3-Dichloropropane	4.76	5.01	4.98	5.26	4.87	5.07	5.09	5.25	
Chlorodibromomethane	4.45	4.36	4.39	4.47	4.07	4.27	4.33	4.46	
1,2-Dibromoethane (EDB)	4.49	4.57	4.37	4.40	4.47	4.44	4.48	4.48	
Chlorobenzene	4.44	4.46	4.61	4.86	4.10	4.21	4.30	4.34	
Ethyl benzene	4.31	4.48	4.65	5.02	4.03	4.27	4.40	4.56	
m&p-Xylene	8.63	8.52	8.78	9.38	7.60	7.89	8.15	8.41	
o-Xylene	4.32	4.33	4.40	4.68	3.79	4.15	4.12	4.15	
Styrene	4.32	4.32	4.44	4.58	4.06	4.10	4.20	4.40	
Bromoform	4.13	4.13	3.94	4.19	4.04	3.94	4.07	4.14	
Isopropylbenzene (cumene)	4.05	4.25	4.34	4.75	3.67	3.89	3.98	4.08	
4-Bromofluorobenzene	52.36	52.18	53.02	53.84	53.49	54.48	54.31	55.32	
1,1,1,2-Tetrachloroethane	4.23	4.14	4.43	4.54	3.90	4.10	4.24	4.20	
1,1,2,2-Tetrachloroethane	4.81	4.77	4.86	5.13	4.85	5.01	5.08	5.14	
1,2,3-Trichloropropane	4.70	4.58	4.62	4.38	4.85	4.62	4.73	4.78	
n-Propylbenzene	4.26	4.42	4.51	5.04	3.92	4.05	4.25	4.40	
o-Chlorotoluene	4.46	4.56	4.62	4.97	4.14	4.50	4.72	4.86	
p-Chlorotoluene	4.60	4.87	4.90	5.24	4.33	4.59	4.78	4.72	
1,2,4-Trimethylbenzene	4.23	4.34	4.43	4.69	3.81	4.05	4.24	4.26	
Bromobenzene	4.38	4.21	4.26	4.39	4.00	3.92	4.06	4.10	
tert-Butylbenzene	4.00	4.14	4.27	4.55	3.57	3.78	3.90	3.90	

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Benzene	4.79	95.8	5	0.27	3.00	0.81	ug/L	1.56	0.56	5.41
n-Heptane	4.62	92.3	5	0.67	3.00	2.00	ug/L	3.84	1.38	13.33
Trichloroethene	4.35	86.9	5	0.34	3.00	1.01	ug/L	1.93	0.69	6.71
Methyl methacrylate	4.31	86.3	5	0.17	3.00	0.52	ug/L	1.00	0.36	3.49
1,2-Dichloropropane	5.00	99.9	5	0.27	3.00	0.81	ug/L	1.55	0.56	5.39
Bromodichloromethane	4.94	98.8	5	0.21	3.00	0.64	ug/L	1.23	0.44	4.27
Dibromomethane	4.88	97.5	5	0.17	3.00	0.51	ug/L	0.98	0.35	3.39
2-Nitropropane	3.62	72.4	5	0.26	3.00	0.79	ug/L	1.51	0.54	5.24
2-Chloroethyl vinyl ether	3.99	79.9	5	0.14	3.00	0.41	ug/L	0.78	0.28	2.70
cis-1,3-Dichloropropene	4.63	92.5	5	0.18	3.00	0.53	ug/L	1.02	0.37	3.54
4-Methyl-2-pentanone	4.58	91.6	5	0.25	3.00	0.76	ug/L	1.46	0.52	5.07
Toluene	4.42	88.5	5	0.26	3.00	0.79	ug/L	1.52	0.55	5.30
trans-1,3-Dichloropropene	4.46	89.2	5	0.09	3.00	0.28	ug/L	0.54	0.20	1.89
1,1,2-Trichloroethane	4.96	99.1	5	0.16	3.00	0.48	ug/L	0.92	0.33	3.21
d8-Toluene	51.71	103.4	50	0.97	3.00	2.90	ug/L	5.57	2.00	1.93
1,2-Dibromoethane	4.43	88.6	5	0.08	3.00	0.23	ug/L	0.45	0.16	1.56
1,4-Dichloro-2-butene	4.45	88.9	5	0.26	3.00	0.78	ug/L	1.49	0.54	5.19
Ethyl methacrylate	4.22	84.3	5	0.09	3.00	0.27	ug/L	0.51	0.19	1.79
2-Hexanone	4.41	88.2	5	0.12	3.00	0.35	ug/L	0.66	0.24	2.31
Tetrachloroethene	3.97	79.4	5	0.41	3.00	1.23	ug/L	2.35	0.85	8.17
1,3-Dichloropropane	5.04	100.7	5	0.17	3.00	0.52	ug/L	0.99	0.36	3.44
Chlorodibromomethane	4.35	87.0	5	0.13	3.00	0.40	ug/L	0.76	0.27	2.66
1,2-Dibromoethane (EDB)	4.46	89.3	5	0.06	3.00	0.18	ug/L	0.35	0.13	1.22
Chlorobenzene	4.42	88.3	5	0.24	3.00	0.72	ug/L	1.37	0.49	4.77
Ethyl benzene	4.47	89.3	5	0.29	3.00	0.88	ug/L	1.70	0.61	5.89
m&p-Xylene	8.42	84.2	10	0.55	3.00	1.65	ug/L	3.18	1.14	5.52
o-Xylene	4.24	84.9	5	0.26	3.00	0.77	ug/L	1.49	0.53	5.16
Styrene	4.30	86.1	5	0.18	3.00	0.53	ug/L	1.01	0.36	3.52
Bromoform	4.07	81.5	5	0.09	3.00	0.28	ug/L	0.54	0.19	1.87
Isopropylbenzene (cumene)	4.13	82.5	5	0.33	3.00	0.98	ug/L	1.88	0.67	6.52
4-Bromofluorobenzene	53.63	107.3	50	1.08	3.00	3.24	ug/L	6.23	2.24	2.16
1,1,1,2-Tetrachloroethane	4.22	84.5	5	0.20	3.00	0.59	ug/L	1.13	0.41	3.93
1,1,2,2-Tetrachloroethane	4.96	99.1	5	0.15	3.00	0.45	ug/L	0.87	0.31	3.01
1,2,3-Trichloropropane	4.66	93.2	5	0.14	3.00	0.43	ug/L	0.83	0.30	2.88
n-Propylbenzene	4.36	87.1	5	0.34	3.00	1.01	ug/L	1.95	0.70	6.77
o-Chlorotoluene	4.60	92.1	5	0.26	3.00	0.77	ug/L	1.48	0.53	5.14
p-Chlorotoluene	4.75	95.1	5	0.27	3.00	0.80	ug/L	1.54	0.55	5.36
1,2,4-Trimethylbenzene	4.26	85.1	5	0.26	3.00	0.78	ug/L	1.49	0.53	5.17
Bromobenzene	4.17	83.3	5	0.17	3.00	0.52	ug/L	1.00	0.36	3.47
tert-Butylbenzene	4.01	80.3	5	0.30	3.00	0.91	ug/L	1.75	0.63	6.08

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
Benzene	Y	6.2	Y	Y
n-Heptane	Y	2.5	Y	Y
Trichloroethene	Y	5.0	Y	Y
Methyl methacrylate	Y	9.6	Y	Y
1,2-Dichloropropane	Y	6.2	Y	Y
Bromodichloromethane	Y	7.8	Y	Y
Dibromomethane	Y	9.8	Y	Y
2-Nitropropane	Y	6.4	Y	Y
2-Chloroethyl vinyl ether	Y	12.3	N	Y
cis-1,3-Dichloropropene	Y	9.4	Y	Y
4-Methyl-2-pentanone	Y	6.6	Y	Y
Toluene	Y	6.3	Y	Y
trans-1,3-Dichloropropene	Y	17.6	N	Y
1,1,2-Trichloroethane	Y	10.4	N	Y
d8-Toluene	Y	17.2	N	Y
1,2-Dibromoethane	Y	21.3	N	Y
1,4-Dichloro-2-butene	Y	6.4	Y	Y
Ethyl methacrylate	Y	18.6	N	Y
2-Hexanone	Y	14.4	N	Y
Tetrachloroethene	Y	4.1	Y	Y
1,3-Dichloropropane	Y	9.7	Y	Y
Chlorodibromomethane	Y	12.6	N	Y
1,2-Dibromoethane (EDB)	Y	27.4	N	Y
Chlorobenzene	Y	7.0	Y	Y
Ethyl benzene	Y	5.7	Y	Y
m&p-Xylene	Y	6.0	Y	Y
o-Xylene	Y	6.5	Y	Y
Styrene	Y	9.5	Y	Y
Bromoform	Y	17.8	N	Y
Isopropylbenzene (cumene)	Y	5.1	Y	Y
4-Bromofluorobenzene	Y	15.4	N	Y
1,1,1,2-Tetrachloroethane	Y	8.5	Y	Y
1,1,2,2-Tetrachloroethane	Y	11.1	N	Y
1,2,3-Trichloropropane	Y	11.6	N	Y
n-Propylbenzene	Y	4.9	Y	Y
o-Chlorotoluene	Y	6.5	Y	Y
p-Chlorotoluene	Y	6.2	Y	Y
1,2,4-Trimethylbenzene	Y	6.5	Y	Y
Bromobenzene	Y	9.6	Y	Y
tert-Butylbenzene	Y	5.5	Y	Y

Method Detection Limit (MDL) Study Final Report

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Compound ID:	a65171.d	a65172.d	a65173.d	a65174.d	a65175.d	a65176.d	a65177.d	a65178.d	
Pentachloroethane	3.90	3.85	3.97	4.05	3.59	3.70	3.74	2.94	
1,3,5-Trimethylbenzene	4.31	4.43	4.46	4.83	4.00	4.12	4.33	4.45	
sec-Butylbenzene	4.14	4.27	4.45	4.81	3.58	3.77	4.04	4.17	
1,3-Dichlorobenzene	4.41	4.41	4.30	4.68	3.95	4.08	4.16	4.16	
p-Isopropyltoluene (cymene)	4.13	4.33	4.35	4.72	3.62	3.83	3.89	4.12	
1,4-Dichlorobenzene	4.40	4.40	4.42	4.73	4.07	4.27	4.20	4.21	
1,2-Dichlorobenzene	4.34	4.38	4.36	4.63	4.11	4.15	4.25	4.25	
n-Butylbenzene	4.32	4.47	4.64	5.25	3.80	4.07	4.39	4.38	
Hexachloroethane	2.77	2.76	2.71	2.94	2.28	2.44	2.56	2.56	
1,2-Dibromo-3-chloropropane	4.56	4.77	4.44	4.82	4.45	4.31	4.86	5.35	
1,2,3-Trichlorobenzene	4.11	4.13	4.04	4.12	3.72	3.59	3.74	3.73	
Hexachlorobutadiene	3.88	3.83	4.03	4.32	3.39	3.46	3.63	3.79	
1,2,4-Trichlorobenzene	4.17	4.12	4.02	4.35	3.83	4.00	3.87	3.83	
Naphthalene	4.89	5.06	4.71	4.94	4.58	4.59	4.63	4.75	

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Pentachloroethane	3.72	74.4	5	0.35	3.00	1.04	ug/L	2.00	0.72	6.96
1,3,5-Trimethylbenzene	4.37	87.3	5	0.25	3.00	0.75	ug/L	1.43	0.52	4.98
sec-Butylbenzene	4.15	83.1	5	0.38	3.00	1.15	ug/L	2.20	0.79	7.64
1,3-Dichlorobenzene	4.27	85.4	5	0.23	3.00	0.69	ug/L	1.32	0.48	4.60
p-Isopropyltoluene (cymene)	4.12	82.5	5	0.35	3.00	1.04	ug/L	2.00	0.72	6.94
1,4-Dichlorobenzene	4.34	86.8	5	0.20	3.00	0.60	ug/L	1.15	0.41	4.00
1,2-Dichlorobenzene	4.31	86.2	5	0.16	3.00	0.49	ug/L	0.93	0.33	3.24
n-Butylbenzene	4.42	88.3	5	0.42	3.00	1.27	ug/L	2.44	0.88	8.48
Hexachloroethane	2.63	52.6	5	0.21	3.00	0.63	ug/L	1.21	0.43	4.19
1,2-Dibromo-3-chloropropane	4.70	93.9	5	0.33	3.00	0.99	ug/L	1.91	0.69	6.63
1,2,3-Trichlorobenzene	3.90	78.0	5	0.22	3.00	0.67	ug/L	1.28	0.46	4.46
Hexachlorobutadiene	3.79	75.8	5	0.30	3.00	0.91	ug/L	1.74	0.63	6.06
1,2,4-Trichlorobenzene	4.02	80.5	5	0.18	3.00	0.55	ug/L	1.06	0.38	3.68
Naphthalene	4.77	95.4	5	0.18	3.00	0.53	ug/L	1.02	0.37	3.54

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
Pentachloroethane	Y	4.8	Y	Y
1,3,5-Trimethylbenzene	Y	6.7	Y	Y
sec-Butylbenzene	Y	4.4	Y	Y
1,3-Dichlorobenzene	Y	7.2	Y	Y
p-Isopropyltoluene (cymene)	Y	4.8	Y	Y
1,4-Dichlorobenzene	Y	8.3	Y	Y
1,2-Dichlorobenzene	Y	10.3	N	Y
n-Butylbenzene	Y	3.9	Y	Y
Hexachloroethane	Y	8.0	Y	Y
1,2-Dibromo-3-chloropropane	Y	5.0	Y	Y
1,2,3-Trichlorobenzene	Y	7.5	Y	Y
Hexachlorobutadiene	Y	5.5	Y	Y
1,2,4-Trichlorobenzene	Y	9.1	Y	Y
Naphthalene	Y	9.4	Y	Y
Outliers:	3		16	0

Method Detection Limit (MDL) Study Final Report

Laboratory:	First Environmental Laboratories, Inc.		
Method / Revision (all):	SW-846 Method 8260B and EPA 600/482-057 Method 624		
Analyte or Analyte Group:	Volatile Soils		
Preparation Analyst:	Not Applicable		
Instrument Analyst:	John Bychowski		
Date of Analysis:	04/11/02		
Instrument ID:	GC/MS "A" with Archon Autosampler		
Instrument Conditions:	Standard		
Est. Detection Limit:	5.0 ug/L		

Calib. Standards Source:	Supelco #5377, #5378	Date Prepared:	02/22/02	01/21/99
Spiking Solution Source:	Supelco #5418, #5419	Date Prepared:	03/13/02	01/12/99
Spiking Concentration:	2.0 ug/kg	Units:	ug/kg	

A minimum of seven replicates was used to perform the MDL study? _X_ yes __no

Were all replicates values used in determining the MDL? _X_ yes __no

If no, submit documentation verifying that the laboratory excluded values which it determined are outliers by using a statistical outlier test.

Has the laboratory established criteria for accepting replicate percent recovery? _X_ yes __no

If yes, the acceptance criteria can be found in MDL SOP page 6. (\pm 50% or per method)

If yes, this MDL study has met the laboratory's criteria for acceptable replicate percent recovery? __yes _X_no

The calculated MDL is greater than "0"? _X_ yes __no

The calculated MDL is greater than 1/10 the MDL spiking concentration? _X_ yes __no

The MDL spiking concentration is greater than the calculated MDL? _X_ yes __no

For drinking water laboratory accreditation, the laboratory has achieved a MDL equal to or less than those specified in Section 186 Appendix A? 186.160(c) __yes __no

Only MDL studies meeting the requirements set forth in Section 186.160 will be deemed acceptable.

Comments: MDL ALSO PERFORMED AT 5.0 ug/kg.

md
Approved by:

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8	#9
	a65179.d	a65180.d	a65181.d	a65182.d	a65183.d	a65184.d	a65189.d	a65190.d	
Dichlorodifluoromethane	0.96	0.92	1.07	1.16	1.23	1.21	1.30	1.42	
Chloromethane	1.74	1.74	1.81	1.98	1.96	2.03	2.03	2.23	
Vinyl Chloride	1.44	1.57	1.56	1.72	1.70	1.86	1.79	2.06	
Bromomethane	3.07	2.95	3.18	3.35	3.36	3.25	3.48	3.94	
Chloroethane	2.08	2.04	2.17	2.29	2.41	2.42	2.31	2.62	
Trichlorofluoromethane	1.43	1.50	1.63	1.72	1.85	1.87	1.98	2.01	
Ethyl ether	2.33	2.30	2.39	2.40	2.54	2.31	2.53	2.45	
Acrolein	4.81	0.00	9.64	14.33	7.98	4.05	4.46	9.51	
Acetone	6.36	6.14	6.03	5.96	5.90	5.59	7.26	7.43	
1,1-Dichloroethene	1.62	1.60	1.77	1.84	1.91	1.86	1.91	2.05	
Iodomethane	1.64	1.69	1.82	1.87	1.97	1.87	2.00	2.10	
Allyl chloride	2.26	2.21	2.41	2.42	2.43	2.49	2.41	2.60	
Methylene chloride	3.50	3.66	4.04	4.10	4.02	4.15	4.27	4.54	
Acrylonitrile	12.95	11.71	12.87	13.29	13.73	12.55	14.01	13.64	
Carbon disulfide	1.71	1.71	1.86	1.91	1.96	1.99	2.06	2.18	
trans-1,2-Dichloroethene	1.86	1.76	1.95	2.02	2.01	2.01	2.15	2.23	
cis-1,2-Dichloroethene	1.79	1.92	2.11	1.99	1.92	2.01	2.10	2.18	
Methyl-t-butyl ether (MTBE)	2.65	2.52	2.74	2.71	2.70	2.66	2.76	2.79	
n-Hexane	0.75	0.89	1.01	0.91	0.56	1.03	1.07	1.09	
Vinyl Acetate	2.62	2.52	2.69	2.74	2.65	2.63	2.88	2.59	
1,1-Dichloroethane	2.16	2.19	2.22	2.32	2.42	2.46	2.56	2.69	
2,2-Dichloropropane	1.57	1.47	1.62	1.64	1.69	1.66	1.70	1.84	
2-Butanone (MEK)	1.20	0.00	1.10	0.75	0.63	0.55	0.00	0.74	
Propionitrile	1.62	0.00	1.14	2.27	0.63	0.48	1.66	1.10	
Methyl acrylate	2.32	2.24	2.51	2.33	2.37	2.16	2.60	2.64	
Bromochloromethane	1.95	1.91	1.99	1.83	1.93	1.97	1.91	2.00	
Methacrylonitrile	2.98	2.83	2.98	3.04	2.95	2.96	3.34	3.19	
Tetrahydrofuran (THF)	3.28	3.68	3.59	3.58	3.59	2.80	3.80	3.41	
Chloroform	5.38	5.37	5.66	5.73	5.59	5.61	5.65	5.65	
Dibromofluoromethane	57.43	57.46	58.87	58.66	58.94	57.70	58.95	59.11	
1,1,1-Trichloroethane	1.59	1.63	1.71	1.80	1.81	1.88	1.79	1.99	
Butyl chloride (1-chlorobutane)	2.63	2.68	2.86	2.85	2.99	3.01	2.94	3.15	
Carbon tetrachloride	1.17	1.26	1.33	1.35	1.38	1.38	1.43	1.54	
1,1-Dichloropropene	1.76	1.79	1.85	1.88	1.87	1.99	1.86	2.03	

Method Detection Limit (MDL) Study Final Report

Note: CL = confidence limit

Check T value @ 99% Confidence Level for No. of replicates in study

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Dichlorodifluoromethane	1.16	57.9	2	0.17	3.00	0.51	ug/kg	0.97	0.35	8.46
Chloromethane	1.94	97.0	2	0.17	3.00	0.51	ug/kg	0.97	0.35	8.43
Vinyl Chloride	1.71	85.6	2	0.20	3.00	0.59	ug/kg	1.12	0.40	9.76
Bromomethane	3.32	166.1	2	0.30	3.00	0.90	ug/kg	1.74	0.62	15.08
Chloroethane	2.29	114.6	2	0.19	3.00	0.58	ug/kg	1.11	0.40	9.66
Trichlorofluoromethane	1.75	87.4	2	0.22	3.00	0.65	ug/kg	1.24	0.45	10.78
Ethyl ether	2.41	120.3	2	0.09	3.00	0.28	ug/kg	0.54	0.19	4.70
Acrolein	6.85	68.5	10	4.42	3.00	13.25	ug/kg	25.44	9.14	44.19
Acetone	6.33	316.7	2	0.66	3.00	1.99	ug/kg	3.81	1.37	33.12
1,1-Dichloroethene	1.82	91.0	2	0.15	3.00	0.46	ug/kg	0.88	0.31	7.61
Iodomethane	1.87	93.5	2	0.15	3.00	0.46	ug/kg	0.89	0.32	7.74
Allyl chloride	2.40	120.2	2	0.12	3.00	0.37	ug/kg	0.71	0.25	6.13
Methylene chloride	4.04	201.8	2	0.33	3.00	0.98	ug/kg	1.89	0.68	16.42
Acrylonitrile	13.09	130.9	10	0.74	3.00	2.23	ug/kg	4.28	1.54	7.43
Carbon disulfide	1.92	96.1	2	0.16	3.00	0.49	ug/kg	0.94	0.34	8.14
trans-1,2-Dichloroethene	2.00	99.9	2	0.15	3.00	0.45	ug/kg	0.86	0.31	7.46
cis-1,2-Dichloroethene	2.00	100.1	2	0.13	3.00	0.38	ug/kg	0.73	0.26	6.31
Methyl-t-butyl ether (MTBE)	2.69	134.6	2	0.08	3.00	0.25	ug/kg	0.48	0.17	4.20
n-Hexane	0.91	45.7	2	0.18	3.00	0.54	ug/kg	1.05	0.38	9.08
Vinyl Acetate	2.67	133.3	2	0.11	3.00	0.33	ug/kg	0.63	0.22	5.43
1,1-Dichloroethane	2.38	118.9	2	0.19	3.00	0.57	ug/kg	1.09	0.39	9.45
2,2-Dichloropropane	1.65	82.4	2	0.11	3.00	0.32	ug/kg	0.62	0.22	5.35
2-Butanone (MEK)	0.62	31.1	2	0.44	3.00	1.33	ug/kg	2.55	0.92	22.14
Propionitrile	1.11	55.6	2	0.73	3.00	2.20	ug/kg	4.22	1.52	36.69
Methyl acrylate	2.40	119.8	2	0.17	3.00	0.51	ug/kg	0.99	0.35	8.56
Bromochloromethane	1.94	96.8	2	0.05	3.00	0.16	ug/kg	0.32	0.11	2.74
Methacrylonitrile	3.03	151.7	2	0.16	3.00	0.48	ug/kg	0.92	0.33	7.97
Tetrahydrofuran (THF)	3.47	173.3	2	0.31	3.00	0.94	ug/kg	1.80	0.65	15.61
Chloroform	5.58	279.0	2	0.13	3.00	0.40	ug/kg	0.77	0.28	6.65
Dibromofluoromethane	58.39	116.8	50	0.73	3.00	2.18	ug/kg	4.19	1.50	1.45
1,1,1-Trichloroethane	1.78	88.8	2	0.13	3.00	0.39	ug/kg	0.75	0.27	6.51
Butyl chloride (1-chlorobutane)	2.89	144.4	2	0.17	3.00	0.52	ug/kg	0.99	0.36	8.63
Carbon tetrachloride	1.36	67.8	2	0.11	3.00	0.33	ug/kg	0.63	0.23	5.51
1,1-Dichloropropene	1.88	93.9	2	0.09	3.00	0.27	ug/kg	0.53	0.19	4.57

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times MDL	MDL Spk Conc is >MDL
Dichlorodifluoromethane	Y	3.9	Y	Y
Chloromethane	Y	4.0	Y	Y
Vinyl Chloride	Y	3.4	Y	Y
Bromomethane	N	2.2	Y	Y
Chloroethane	Y	3.5	Y	Y
Trichlorofluoromethane	Y	3.1	Y	Y
Ethyl ether	Y	7.1	Y	Y
Acrolein	Y	0.8	Y	N
Acetone	N	1.0	Y	Y
1,1-Dichloroethene	Y	4.4	Y	Y
Iodomethane	Y	4.3	Y	Y
Allyl chloride	Y	5.4	Y	Y
Methylene chloride	N	2.0	Y	Y
Acrylonitrile	Y	4.5	Y	Y
Carbon disulfide	Y	4.1	Y	Y
trans-1,2-Dichloroethene	Y	4.5	Y	Y
cis-1,2-Dichloroethene	Y	5.3	Y	Y
Methyl-t-butyl ether (MTBE)	Y	8.0	Y	Y
n-Hexane	N	3.7	Y	Y
Vinyl Acetate	Y	6.1	Y	Y
1,1-Dichloroethane	Y	3.5	Y	Y
2,2-Dichloropropane	Y	6.2	Y	Y
2-Butanone (MEK)	N	1.5	Y	Y
Propionitrile	Y	0.9	Y	N
Methyl acrylate	Y	3.9	Y	Y
Bromochloromethane	Y	12.2	N	Y
Methacrylonitrile	N	4.2	Y	Y
Tetrahydrofuran (THF)	N	2.1	Y	Y
Chloroform	N	5.0	Y	Y
Dibromofluoromethane	Y	22.9	N	Y
1,1,1-Trichloroethane	Y	5.1	Y	Y
Butyl chloride (1-chlorobutane)	Y	3.9	Y	Y
Carbon tetrachloride	Y	6.1	Y	Y
1,1-Dichloropropene	Y	7.3	Y	Y

Method Detection Limit (MDL) Study Final Report

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Compound ID:	a65179.d	a65180.d	a65181.d	a65182.d	a65183.d	a65184.d	a65189.d	a65190.d	
1,2-Dichloroethane	2.33	2.38	2.41	2.43	2.46	2.47	2.64	2.59	
Benzene	1.86	1.89	2.03	1.96	2.09	2.12	2.18	2.24	
n-Heptane	0.38	0.44	0.45	0.50	0.44	0.53	0.56	0.54	
Trichloroethene	1.67	1.61	1.80	1.77	1.85	1.81	2.00	1.93	
Methyl methacrylate	1.86	1.67	1.90	2.05	1.92	1.86	2.08	2.01	
1,2-Dichloropropane	2.16	2.11	2.31	2.36	2.26	2.22	2.29	2.32	
Bromodichloromethane	2.23	2.38	2.38	2.43	2.47	2.40	2.50	2.54	
Dibromomethane	2.11	2.20	2.21	2.06	2.25	2.23	2.33	2.31	
2-Nitropropane	1.51	1.70	1.43	2.30	1.78	2.04	2.21	1.92	
2-Chloroethyl vinyl ether	1.77	1.49	1.38	1.93	1.61	1.61	1.72	1.95	
cis-1,3-Dichloropropene	1.96	1.94	2.23	2.04	2.08	2.02	2.11	2.20	
4-Methyl-2-pentanone	2.49	2.24	2.53	2.55	2.42	2.49	2.70	2.82	
Toluene	1.79	1.77	1.93	1.89	1.93	2.00	1.93	2.13	
trans-1,3-Dichloropropene	2.03	2.00	1.97	1.96	2.00	2.06	2.20	2.12	
1,1,2-Trichloroethane	2.34	2.45	2.50	2.40	2.47	2.27	2.70	2.74	
d8-Toluene	52.65	52.90	53.35	53.09	53.02	53.34	53.97	54.43	
1,2-Dibromoethane	2.16	2.01	2.07	2.16	2.06	2.13	2.23	2.11	
1,4-Dichloro-2-butene	2.08	2.30	2.00	1.94	2.06	2.07	2.16	2.18	
Ethyl methacrylate	1.89	1.99	2.03	1.95	2.01	1.88	2.26	1.99	
2-Hexanone	2.24	1.95	2.29	2.42	2.33	2.04	2.46	2.39	
Tetrachloroethene	1.32	1.34	1.39	1.40	1.43	1.49	1.49	1.65	
1,3-Dichloropropane	2.34	2.30	2.47	2.39	2.59	2.49	2.55	2.58	
Chlorodibromomethane	2.19	2.13	2.18	2.21	2.17	2.10	2.35	2.25	
1,2-Dibromoethane (EDB)	2.17	2.00	2.03	2.16	2.05	2.16	2.23	2.12	
Chlorobenzene	1.95	1.93	1.99	1.97	2.01	2.09	2.03	2.12	
Ethyl benzene	1.81	1.85	1.92	1.93	2.01	2.04	2.00	2.15	
m&p-Xylene	3.36	3.42	3.50	3.49	3.62	3.73	3.68	3.80	
o-Xylene	1.71	1.68	1.86	1.81	1.82	1.90	1.89	1.98	
Styrene	1.88	1.85	2.00	1.91	1.97	1.92	1.96	2.12	
Bromoform	2.15	2.08	2.00	2.11	2.20	2.11	2.25	2.32	
Isopropylbenzene (cumene)	1.67	1.60	1.72	1.76	1.75	1.85	1.77	1.92	
4-Bromofluorobenzene	54.37	54.63	54.38	55.74	54.99	55.13	56.30	56.97	
1,1,1,2-Tetrachloroethane	1.94	2.11	2.12	2.10	2.10	2.10	2.16	2.15	
1,1,2,2-Tetrachloroethane	2.94	2.97	2.80	3.10	2.89	2.81	3.08	2.89	
1,2,3-Trichloropropane	2.43	2.50	2.52	2.49	2.32	2.26	2.63	2.54	
n-Propylbenzene	1.86	1.92	1.89	1.95	2.00	2.00	1.97	2.13	
o-Chlorotoluene	2.31	2.32	2.37	2.45	2.40	2.49	2.48	2.53	
p-Chlorotoluene	2.26	2.29	2.30	2.36	2.38	2.41	2.37	2.46	
1,2,4-Trimethylbenzene	1.90	1.90	1.96	1.97	2.03	2.05	2.03	2.18	

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
1,2-Dichloroethane	2.46	123.2	2	0.10	3.00	0.31	ug/kg	0.60	0.22	5.21
Benzene	2.05	102.3	2	0.14	3.00	0.41	ug/kg	0.78	0.28	6.80
n-Heptane	0.48	24.0	2	0.06	3.00	0.19	ug/kg	0.36	0.13	3.11
Trichloroethene	1.81	90.3	2	0.13	3.00	0.38	ug/kg	0.73	0.26	6.36
Methyl methacrylate	1.92	95.9	2	0.13	3.00	0.39	ug/kg	0.76	0.27	6.57
1,2-Dichloropropane	2.25	112.7	2	0.09	3.00	0.26	ug/kg	0.49	0.18	4.26
Bromodichloromethane	2.42	120.8	2	0.09	3.00	0.28	ug/kg	0.55	0.20	4.74
Dibromomethane	2.21	110.6	2	0.09	3.00	0.28	ug/kg	0.53	0.19	4.59
2-Nitropropane	1.86	93.1	2	0.31	3.00	0.94	ug/kg	1.81	0.65	15.71
2-Chloroethyl vinyl ether	1.68	84.1	2	0.20	3.00	0.60	ug/kg	1.15	0.41	10.02
cis-1,3-Dichloropropene	2.07	103.6	2	0.10	3.00	0.31	ug/kg	0.60	0.22	5.23
4-Methyl-2-pentanone	2.53	126.5	2	0.17	3.00	0.52	ug/kg	1.00	0.36	8.72
Toluene	1.92	96.1	2	0.11	3.00	0.34	ug/kg	0.66	0.24	5.70
trans-1,3-Dichloropropene	2.04	102.1	2	0.08	3.00	0.25	ug/kg	0.47	0.17	4.09
1,1,2-Trichloroethane	2.48	124.2	2	0.16	3.00	0.49	ug/kg	0.94	0.34	8.18
d8-Toluene	53.34	106.7	50	0.59	3.00	1.76	ug/kg	3.38	1.22	1.18
1,2-Dibromoethane	2.12	105.8	2	0.07	3.00	0.21	ug/kg	0.40	0.14	3.46
1,4-Dichloro-2-butene	2.10	104.9	2	0.11	3.00	0.34	ug/kg	0.65	0.23	5.62
Ethyl methacrylate	2.00	100.0	2	0.12	3.00	0.35	ug/kg	0.68	0.24	5.91
2-Hexanone	2.27	113.3	2	0.18	3.00	0.55	ug/kg	1.05	0.38	9.12
Tetrachloroethene	1.44	71.9	2	0.11	3.00	0.32	ug/kg	0.61	0.22	5.27
1,3-Dichloropropane	2.46	123.2	2	0.11	3.00	0.33	ug/kg	0.63	0.23	5.52
Chlorodibromomethane	2.20	109.9	2	0.08	3.00	0.23	ug/kg	0.44	0.16	3.84
1,2-Dibromoethane (EDB)	2.12	105.8	2	0.08	3.00	0.24	ug/kg	0.46	0.17	4.01
Chlorobenzene	2.01	100.6	2	0.07	3.00	0.20	ug/kg	0.38	0.14	3.32
Ethyl benzene	1.96	98.2	2	0.11	3.00	0.33	ug/kg	0.63	0.23	5.46
m&p-Xylene	3.58	89.4	4	0.16	3.00	0.47	ug/kg	0.90	0.32	3.91
o-Xylene	1.83	91.6	2	0.10	3.00	0.30	ug/kg	0.57	0.21	4.97
Styrene	1.95	97.6	2	0.08	3.00	0.25	ug/kg	0.48	0.17	4.20
Bromoform	2.15	107.6	2	0.10	3.00	0.30	ug/kg	0.58	0.21	5.07
Isopropylbenzene (cumene)	1.76	87.8	2	0.10	3.00	0.30	ug/kg	0.57	0.21	4.96
4-Bromofluorobenzene	55.31	110.6	50	0.95	3.00	2.84	ug/kg	5.45	1.96	1.89
1,1,1,2-Tetrachloroethane	2.10	104.9	2	0.07	3.00	0.20	ug/kg	0.39	0.14	3.39
1,1,2,2-Tetrachloroethane	2.94	146.8	2	0.11	3.00	0.33	ug/kg	0.64	0.23	5.59
1,2,3-Trichloropropane	2.46	123.1	2	0.12	3.00	0.36	ug/kg	0.69	0.25	6.03
n-Propylbenzene	1.97	98.3	2	0.08	3.00	0.25	ug/kg	0.48	0.17	4.17
o-Chlorotoluene	2.42	120.9	2	0.08	3.00	0.24	ug/kg	0.47	0.17	4.07
p-Chlorotoluene	2.35	117.7	2	0.07	3.00	0.20	ug/kg	0.38	0.14	3.34
1,2,4-Trimethylbenzene	2.00	100.1	2	0.09	3.00	0.28	ug/kg	0.53	0.19	4.60

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
1,2-Dichloroethane	Y	6.4	Y	Y
Benzene	Y	4.9	Y	Y
n-Heptane	N	10.7	N	Y
Trichloroethene	Y	5.2	Y	Y
Methyl methacrylate	Y	5.1	Y	Y
1,2-Dichloropropane	Y	7.8	Y	Y
Bromodichloromethane	Y	7.0	Y	Y
Dibromomethane	Y	7.3	Y	Y
2-Nitropropane	Y	2.1	Y	Y
2-Chloroethyl vinyl ether	Y	3.3	Y	Y
cis-1,3-Dichloropropene	Y	6.4	Y	Y
4-Methyl-2-pentanone	Y	3.8	Y	Y
Toluene	Y	5.8	Y	Y
trans-1,3-Dichloropropene	Y	8.1	Y	Y
1,1,2-Trichloroethane	Y	4.1	Y	Y
d8-Toluene	Y	28.4	N	Y
1,2-Dibromoethane	Y	9.6	Y	Y
1,4-Dichloro-2-butene	Y	5.9	Y	Y
Ethyl methacrylate	Y	5.6	Y	Y
2-Hexanone	Y	3.7	Y	Y
Tetrachloroethene	Y	6.3	Y	Y
1,3-Dichloropropane	Y	6.0	Y	Y
Chlorodibromomethane	Y	8.7	Y	Y
1,2-Dibromoethane (EDB)	Y	8.3	Y	Y
Chlorobenzene	Y	10.0	N	Y
Ethyl benzene	Y	6.1	Y	Y
m&p-Xylene	Y	8.5	Y	Y
o-Xylene	Y	6.7	Y	Y
Styrene	Y	8.0	Y	Y
Bromoform	Y	6.6	Y	Y
Isopropylbenzene (cumene)	Y	6.7	Y	Y
4-Bromofluorobenzene	Y	17.6	N	Y
1,1,1,2-Tetrachloroethane	Y	9.8	Y	Y
1,1,2,2-Tetrachloroethane	Y	6.0	Y	Y
1,2,3-Trichloropropane	Y	5.5	Y	Y
n-Propylbenzene	Y	8.0	Y	Y
o-Chlorotoluene	Y	8.2	Y	Y
p-Chlorotoluene	Y	10.0	Y	Y
1,2,4-Trimethylbenzene	Y	7.3	Y	Y

Method Detection Limit (MDL) Study Final Report

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Compound ID:	a65179.d	a65180.d	a65181.d	a65182.d	a65183.d	a65184.d	a65189.d	a65190.d	
Bromobenzene	2.09	2.07	2.06	2.06	1.99	2.01	2.05	2.01	
tert-Butylbenzene	1.76	1.82	1.83	1.88	1.83	1.91	1.93	1.98	
Pentachloroethane	1.95	2.02	2.01	1.97	1.98	1.96	2.00	1.90	
1,3,5-Trimethylbenzene	2.06	2.04	2.12	2.08	2.04	2.13	2.09	2.17	
sec-Butylbenzene	1.72	1.73	1.79	1.77	1.79	1.84	1.78	1.96	
1,3-Dichlorobenzene	2.11	2.08	2.04	2.18	2.12	2.16	2.13	2.14	
p-Isopropyltoluene (cymene)	1.84	1.86	1.89	1.93	1.92	1.93	1.96	2.03	
1,4-Dichlorobenzene	2.23	2.17	2.28	2.23	2.28	2.22	2.18	2.20	
1,2-Dichlorobenzene	2.23	2.22	2.23	2.21	2.16	2.17	2.24	2.20	
n-Butylbenzene	1.85	1.96	2.02	2.02	1.97	2.02	1.90	2.06	
Hexachloroethane	1.23	1.22	1.21	1.15	1.19	1.27	1.33	1.38	
1,2-Dibromo-3-chloropropane	2.90	2.35	2.58	2.12	2.53	2.65	3.08	2.52	
1,2,3-Trichlorobenzene	1.89	1.84	1.87	1.88	1.75	1.72	1.75	1.78	
Hexachlorobutadiene	1.59	1.61	1.71	1.66	1.69	1.73	1.68	1.71	
1,2,4-Trichlorobenzene	2.02	1.92	1.95	1.89	1.92	1.87	1.94	1.94	
Naphthalene	2.71	2.49	2.42	2.44	2.38	2.27	2.76	2.49	

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Bromobenzene	2.04	102.1	2	0.03	3.00	0.10	ug/kg	0.20	0.07	1.75
tert-Butylbenzene	1.87	93.4	2	0.07	3.00	0.21	ug/kg	0.41	0.15	3.54
Pentachloroethane	1.97	98.7	2	0.04	3.00	0.12	ug/kg	0.22	0.08	1.93
1,3,5-Trimethylbenzene	2.09	104.6	2	0.05	3.00	0.14	ug/kg	0.27	0.10	2.31
sec-Butylbenzene	1.80	89.9	2	0.08	3.00	0.23	ug/kg	0.43	0.16	3.78
1,3-Dichlorobenzene	2.12	106.0	2	0.04	3.00	0.13	ug/kg	0.26	0.09	2.22
p-Isopropyltoluene (cymene)	1.92	96.0	2	0.06	3.00	0.18	ug/kg	0.34	0.12	2.98
1,4-Dichlorobenzene	2.22	111.2	2	0.04	3.00	0.12	ug/kg	0.24	0.08	2.05
1,2-Dichlorobenzene	2.21	110.4	2	0.03	3.00	0.09	ug/kg	0.17	0.06	1.46
n-Butylbenzene	1.98	98.8	2	0.07	3.00	0.21	ug/kg	0.41	0.15	3.53
Hexachloroethane	1.25	62.4	2	0.08	3.00	0.23	ug/kg	0.44	0.16	3.79
1,2-Dibromo-3-chloropropane	2.59	129.6	2	0.30	3.00	0.90	ug/kg	1.72	0.62	14.96
1,2,3-Trichlorobenzene	1.81	90.5	2	0.07	3.00	0.20	ug/kg	0.39	0.14	3.38
Hexachlorobutadiene	1.67	83.6	2	0.05	3.00	0.15	ug/kg	0.29	0.10	2.49
1,2,4-Trichlorobenzene	1.93	96.6	2	0.04	3.00	0.13	ug/kg	0.26	0.09	2.24
Naphthalene	2.50	124.8	2	0.16	3.00	0.49	ug/kg	0.95	0.34	8.22

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
Bromobenzene	Y	19.1	N	Y
tert-Butylbenzene	Y	9.4	Y	Y
Pentachloroethane	Y	17.3	N	Y
1,3,5-Trimethylbenzene	Y	14.5	N	Y
sec-Butylbenzene	Y	8.8	Y	Y
1,3-Dichlorobenzene	Y	15.0	N	Y
p-Isopropyltoluene (cymene)	Y	11.2	N	Y
1,4-Dichlorobenzene	Y	16.3	N	Y
1,2-Dichlorobenzene	Y	22.9	N	Y
n-Butylbenzene	Y	9.5	Y	Y
Hexachloroethane	Y	8.8	Y	Y
1,2-Dibromo-3-chloropropane	Y	2.2	Y	Y
1,2,3-Trichlorobenzene	Y	9.9	Y	Y
Hexachlorobutadiene	Y	13.4	N	Y
1,2,4-Trichlorobenzene	Y	14.9	N	Y
Naphthalene	Y	4.1	Y	Y
Outliers:	9		15	2

Method Detection Limit (MDL) Study Final Report

Laboratory:	First Environmental Laboratories, Inc.		
Method / Revision (all):	SW-846 Method 8260B/EPA 600/482-057 Method 624		
Analyte or Analyte Group:	Volatiles - Aqueous		
Preparation Analyst:	Not Applicable		
Instrument Analyst:	Pam Hentschel		
Date of Analysis:	03/28/02		
Instrument ID:	GC/MS "C" with Archon Autosampler		
Instrument Conditions:	Standard		
Est. Detection Limit:	5.0 ug/L		

Calib. Standards Source:	Supelco #5377, #5378	Date Prepared:	02/22/02
Spiking Solution Source:	Supelco #5418, #5419	Date Prepared:	03/13/02
Spiking Concentration:	5.0 ug/L	Units:	ug/L

A minimum of seven replicates was used to perform the MDL study? _X_ yes __no

Were all replicates values used in determining the MDL? _X_ yes __no

If no, submit documentation verifying that the laboratory excluded values which it determined are outliers by using a statistical outlier test.

Has the laboratory established criteria for accepting replicate percent recovery? _X_ yes __no

If yes, the acceptance criteria can be found in MDL SOP page 6. (\pm 50% or per method)

If yes, this MDL study has met the laboratory's criteria for acceptable replicate percent recovery? __yes Xno

The calculated MDL is greater than "0"? _X_ yes __no

The calculated MDL is greater than 1/10 the MDL spiking concentration? _X_ yes __no

The MDL spiking concentration is greater than the calculated MDL? _X_ yes __no

For drinking water laboratory accreditation, the laboratory has achieved a MDL equal to or less than those specified in Section 186 Appendix A? 186.160(c) __yes __no

Only MDL studies meeting the requirements set forth in Section 186.160 will be deemed acceptable.

Comments: * MDL study also performed at 2.0 ug/L.

7 outliers; Spike recovery. _____


Approved by: _____

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8
	c57732.d	c57733.d	c57734.d	c57735.d	c57736.d	c57737.d	c57738.d	C57739.D
Dichlorodifluoromethane	5.78	4.42	4.95	4.89	5.02	4.73	4.94	4.87
Chloromethane	5.01	3.71	4.16	2.98	4.00	3.88	4.18	3.92
Vinyl Chloride	5.98	4.72	5.02	5.00	5.15	4.60	4.70	4.80
Bromomethane	9.51	6.30	7.82	14.43	8.15	6.21	6.27	7.20
Chloroethane	6.96	5.24	5.51	5.88	6.29	4.88	5.28	5.24
Trichlorofluoromethane	6.50	4.79	5.37	5.45	5.55	4.98	5.41	5.20
Ethyl ether	5.08	4.50	5.46	5.37	5.62	4.88	5.34	5.20
Acrolein	27.27	25.38	28.94	28.09	27.35	34.07	35.67	31.91
Acetone	7.43	5.90	6.03	4.18	5.19	5.00	6.20	5.57
1,1-Dichloroethene	3.96	4.59	4.81	4.98	5.00	4.86	5.12	5.21
Iodomethane	4.25	3.39	3.65	7.56	4.05	3.34	3.42	3.55
Allyl chloride	9.02	4.53	8.98	9.42	10.10	2.71	3.64	2.48
Methylene chloride	5.77	5.52	5.39	4.74	5.50	5.07	5.24	5.29
Acrylonitrile	22.73	25.82	25.46	25.24	27.56	26.03	26.10	24.71
Carbon disulfide	5.52	4.91	4.81	4.47	4.77	4.00	4.34	4.22
trans-1,2-Dichloroethene	5.52	4.82	5.22	5.01	5.20	4.56	4.99	4.90
cis-1,2-Dichloroethene	5.14	4.39	4.97	4.93	5.05	4.30	4.76	4.68
Methyl-t-butyl ether (MTBE)	5.70	5.49	5.67	5.50	5.75	4.65	5.29	4.70
n-Hexane	4.80	4.41	4.53	4.79	4.48	4.69	4.47	4.33
Vinyl Acetate	5.22	4.98	4.94	5.54	5.05	3.20	4.48	2.97
1,1-Dichloroethane	5.32	5.04	5.43	5.34	5.48	4.64	4.93	5.12
2,2-Dichloropropane	13.96	8.91	13.19	12.97	12.97	1.02	3.36	0.81
2-Butanone (MEK)	2.89	1.90	3.16	2.03	2.83	1.78	1.91	2.77
Propionitrile	3.69	2.61	2.86	2.00	2.96	2.20	2.83	2.53
Methyl acrylate	2.84	2.06	2.31	2.89	2.34	2.90	2.73	2.91
Bromochloromethane	5.94	5.14	6.04	6.51	6.31	4.99	5.03	5.24
Methacrylonitrile	4.88	3.67	4.49	4.48	4.79	4.53	4.74	4.92
Tetrahydrofuran (THF)	5.57	4.78	5.27	4.62	5.64	4.30	5.52	5.84
Chloroform	6.63	5.74	6.49	6.27	6.33	5.83	6.03	6.05
Dibromofluoromethane	55.60	51.67	56.54	57.98	57.72	51.78	52.73	52.53
1,1,1-Trichloroethane	5.91	5.39	5.40	5.69	5.74	4.66	5.71	4.48
Butyl chloride (1-chlorobutane)	5.70	5.23	5.35	5.13	5.26	5.15	5.32	5.22
Carbon tetrachloride	6.11	5.38	5.48	5.38	5.56	5.12	5.71	4.53
1,1-Dichloropropene	4.99	4.60	4.64	5.36	4.81	4.61	5.08	4.91

Method Detection Limit (MDL) Study Final Report

Note: CL = confidence limit

Check T value @ 99% Confidence Level for No. of replicates in study

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Dichlorodifluoromethane	4.95	99.0	5	0.38	3.00	1.15	ug/L	2.21	0.79	7.7
Chloromethane	3.98	79.6	5	0.56	3.00	1.69	ug/L	3.24	1.17	11.3
Vinyl Chloride	5.00	99.9	5	0.44	3.00	1.32	ug/L	2.53	0.91	8.8
Bromomethane	8.24	164.7	5	2.75	3.00	8.25	ug/L	15.83	5.69	55.0
Chloroethane	5.66	113.2	5	0.68	3.00	2.05	ug/L	3.93	1.41	13.7
Trichlorofluoromethane	5.41	108.1	5	0.51	3.00	1.53	ug/L	2.94	1.06	10.2
Ethyl ether	5.18	103.6	5	0.36	3.00	1.07	ug/L	2.06	0.74	7.2
Acrolein	29.84	119.3	25	3.64	3.00	10.91	ug/L	20.95	7.53	14.6
Acetone	5.69	113.8	5	0.96	3.00	2.88	ug/L	5.53	1.99	19.2
1,1-Dichloroethene	4.82	96.3	5	0.40	3.00	1.19	ug/L	2.28	0.82	7.9
Iodomethane	4.15	83.0	5	1.42	3.00	4.24	ug/L	8.15	2.93	28.3
Allyl chloride	6.36	127.2	5	3.30	3.00	9.91	ug/L	19.02	6.83	66.1
Methylene chloride	5.32	106.3	5	0.31	3.00	0.94	ug/L	1.80	0.65	6.3
Acrylonitrile	25.46	101.8	25	1.38	3.00	4.14	ug/L	7.95	2.86	5.5
Carbon disulfide	4.63	92.6	5	0.48	3.00	1.43	ug/L	2.75	0.99	9.6
trans-1,2-Dichloroethene	5.03	100.6	5	0.29	3.00	0.87	ug/L	1.67	0.60	5.8
cis-1,2-Dichloroethene	4.78	95.6	5	0.31	3.00	0.92	ug/L	1.76	0.63	6.1
Methyl-t-butyl ether (MTBE)	5.34	106.9	5	0.44	3.00	1.31	ug/L	2.52	0.91	8.8
n-Hexane	4.56	91.3	5	0.18	3.00	0.53	ug/L	1.02	0.37	3.5
Vinyl Acetate	4.55	91.0	5	0.95	3.00	2.85	ug/L	5.48	1.97	19.0
1,1-Dichloroethane	5.16	103.3	5	0.29	3.00	0.86	ug/L	1.65	0.59	5.7
2,2-Dichloropropane	8.40	168.0	5	5.77	3.00	17.31	ug/L	33.24	11.94	115.5
2-Butanone (MEK)	2.41	48.2	5	0.55	3.00	1.66	ug/L	3.19	1.15	11.1
Propionitrile	2.71	54.2	5	0.52	3.00	1.55	ug/L	2.97	1.07	10.3
Methyl acrylate	2.62	52.5	5	0.33	3.00	1.00	ug/L	1.93	0.69	6.7
Bromochloromethane	5.65	113.0	5	0.62	3.00	1.85	ug/L	3.55	1.28	12.3
Methacrylonitrile	4.56	91.3	5	0.40	3.00	1.20	ug/L	2.30	0.83	8.0
Tetrahydrofuran (THF)	5.19	103.9	5	0.56	3.00	1.67	ug/L	3.20	1.15	11.1
Chloroform	6.17	123.4	5	0.31	3.00	0.94	ug/L	1.80	0.65	6.3
Dibromofluoromethane	54.57	109.1	50	2.68	3.00	8.03	ug/L	15.42	5.54	5.4
1,1,1-Trichloroethane	5.37	107.5	5	0.53	3.00	1.58	ug/L	3.03	1.09	10.5
Butyl chloride (1-chlorobutane)	5.30	105.9	5	0.18	3.00	0.54	ug/L	1.04	0.37	3.6
Carbon tetrachloride	5.41	108.2	5	0.46	3.00	1.37	ug/L	2.64	0.95	9.2
1,1-Dichloropropene	4.88	97.5	5	0.27	3.00	0.80	ug/L	1.53	0.55	5.3

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times MDL	MDL Spk Conc is >MDL
Dichlorodifluoromethane	Y	4.3	Y	Y
Chloromethane	Y	3.0	Y	Y
Vinyl Chloride	Y	3.8	Y	Y
Bromomethane	N	0.6	Y	N
Chloroethane	Y	2.4	Y	Y
Trichlorofluoromethane	Y	3.3	Y	Y
Ethyl ether	Y	4.7	Y	Y
Acrolein	Y	2.3	Y	Y
Acetone	Y	1.7	Y	Y
1,1-Dichloroethene	Y	4.2	Y	Y
Iodomethane	Y	1.2	Y	Y
Allyl chloride	Y	0.5	Y	N
Methylene chloride	Y	5.3	Y	Y
Acrylonitrile	Y	6.0	Y	Y
Carbon disulfide	Y	3.5	Y	Y
trans-1,2-Dichloroethene	Y	5.7	Y	Y
cis-1,2-Dichloroethene	Y	5.5	Y	Y
Methyl-t-butyl ether (MTBE)	Y	3.8	Y	Y
n-Hexane	Y	9.4	Y	Y
Vinyl Acetate	Y	1.8	Y	Y
1,1-Dichloroethane	Y	5.8	Y	Y
2,2-Dichloropropane	N	0.3	Y	N
2-Butanone (MEK)	N	3.0	Y	Y
Propionitrile	Y	3.2	Y	Y
Methyl acrylate	Y	5.0	Y	Y
Bromochloromethane	Y	2.7	Y	Y
Methacrylonitrile	Y	4.2	Y	Y
Tetrahydrofuran (THF)	Y	3.0	Y	Y
Chloroform	Y	5.3	Y	Y
Dibromofluoromethane	Y	6.2	Y	Y
1,1,1-Trichloroethane	Y	3.2	Y	Y
Butyl chloride (1-chlorobutane)	Y	9.3	Y	Y
Carbon tetrachloride	Y	3.6	Y	Y
1,1-Dichloropropene	Y	6.3	Y	Y

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8
	c57732.d	c57733.d	c57734.d	c57735.d	c57736.d	c57737.d	c57738.d	C57739.D
1,2-Dichloroethane	5.46	4.95	5.66	5.73	6.20	4.96	5.26	4.92
Benzene	5.15	4.80	4.47	4.79	4.69	4.86	4.85	4.82
n-Heptane	4.24	4.23	4.13	4.09	4.18	3.63	3.97	4.02
Trichloroethene	5.17	4.57	4.42	4.72	4.80	4.75	4.97	4.62
Methyl methacrylate	3.40	2.99	2.95	3.20	2.73	2.80	2.84	3.13
1,2-Dichloropropane	4.88	4.74	4.49	4.50	4.60	5.05	4.98	4.92
Bromodichloromethane	5.61	5.43	5.08	5.46	5.17	4.49	5.08	4.32
Dibromomethane	7.21	6.35	7.73	7.32	8.12	5.17	5.49	5.81
2-Nitropropane	3.75	3.11	4.53	4.21	4.30	3.47	3.36	3.95
2-Chloroethyl vinyl ether	2.73	3.02	2.34	2.79	2.30	2.53	2.51	2.58
cis-1,3-Dichloropropene	4.33	4.35	3.67	4.05	3.97	3.87	3.72	3.93
4-Methyl-2-pentanone	4.14	4.20	4.00	4.17	4.56	4.47	4.37	4.44
Toluene	4.79	4.46	4.50	4.67	4.56	4.55	4.86	4.67
trans-1,3-Dichloropropene	2.52	2.62	2.66	2.68	2.71	2.75	2.62	2.72
1,1,2-Trichloroethane	4.33	4.66	4.44	4.86	4.81	4.88	4.85	4.47
d8-Toluene	52.04	50.05	48.83	49.88	51.26	49.46	50.02	49.07
1,2-Dibromoethane	3.81	4.08	4.18	4.31	4.31	4.43	4.32	4.44
1,4-Dichloro-2-butene	0.91	0.83	0.92	0.60	0.49	0.52	1.04	0.54
Ethyl methacrylate	1.80	2.64	2.09	2.12	2.17	2.25	1.98	2.63
2-Hexanone	1.10	1.96	1.83	1.53	1.61	1.68	1.38	2.01
Tetrachloroethene	3.95	5.04	4.76	4.93	4.86	4.86	4.74	5.00
1,3-Dichloropropane	3.46	4.81	4.87	4.82	4.70	4.56	4.33	4.50
Chlorodibromomethane	3.32	4.26	4.43	4.64	4.38	4.37	4.17	4.49
1,2-Dibromoethane (EDB)	3.00	4.25	4.08	4.54	4.40	4.39	4.31	4.50
Chlorobenzene	3.80	4.38	4.54	4.54	4.72	4.70	4.44	4.70
Ethyl benzene	3.49	4.10	4.10	4.13	4.12	4.33	3.96	4.24
m&p-Xylene	6.81	7.86	7.94	8.17	8.48	8.31	7.90	8.35
o-Xylene	3.24	4.12	4.08	3.91	4.05	3.90	3.78	3.95
Styrene	3.18	3.64	3.39	3.82	3.57	3.51	3.68	3.77
Bromoform	2.95	4.11	4.02	4.38	4.01	4.10	3.98	3.85
Isopropylbenzene (cumene)	3.11	3.86	3.83	3.79	3.96	4.02	3.89	3.86
4-Bromofluorobenzene	49.66	46.21	44.91	47.65	46.07	44.79	44.13	44.76
1,1,1,2-Tetrachloroethane	3.69	4.80	4.70	4.80	4.70	4.61	4.37	4.45
1,1,2,2-Tetrachloroethane	3.42	5.20	5.33	5.64	5.71	5.91	5.86	5.59
1,2,3-Trichloropropane	3.35	4.68	5.11	5.81	5.12	6.03	6.27	5.72
n-Propylbenzene	3.11	4.49	4.23	4.86	4.87	4.60	4.50	4.72
o-Chlorotoluene	3.22	5.05	5.20	5.63	5.28	5.55	5.61	5.17
p-Chlorotoluene	3.06	4.47	4.90	5.18	5.05	5.08	5.10	4.80
1,2,4-Trimethylbenzene	3.18	4.74	4.86	4.87	5.03	5.07	4.96	4.85

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
1,2-Dichloroethane	5.39	107.9	5	0.46	3.00	1.37	ug/L	2.63	0.95	9.2
Benzene	4.80	96.1	5	0.19	3.00	0.57	ug/L	1.09	0.39	3.8
n-Heptane	4.06	81.2	5	0.20	3.00	0.60	ug/L	1.14	0.41	4.0
Trichloroethene	4.75	95.1	5	0.23	3.00	0.70	ug/L	1.35	0.49	4.7
Methyl methacrylate	3.01	60.1	5	0.23	3.00	0.68	ug/L	1.30	0.47	4.5
1,2-Dichloropropane	4.77	95.4	5	0.22	3.00	0.66	ug/L	1.27	0.45	4.4
Bromodichloromethane	5.08	101.6	5	0.46	3.00	1.38	ug/L	2.65	0.95	9.2
Dibromomethane	6.65	133.0	5	1.10	3.00	3.29	ug/L	6.31	2.27	21.9
2-Nitropropane	3.84	76.7	5	0.50	3.00	1.50	ug/L	2.87	1.03	10.0
2-Chloroethyl vinyl ether	2.60	52.0	5	0.24	3.00	0.72	ug/L	1.38	0.49	4.8
cis-1,3-Dichloropropene	3.99	79.7	5	0.25	3.00	0.75	ug/L	1.45	0.52	5.0
4-Methyl-2-pentanone	4.29	85.9	5	0.19	3.00	0.58	ug/L	1.12	0.40	3.9
Toluene	4.63	92.7	5	0.14	3.00	0.42	ug/L	0.81	0.29	2.8
trans-1,3-Dichloropropene	2.66	53.2	5	0.07	3.00	0.22	ug/L	0.42	0.15	1.5
1,1,2-Trichloroethane	4.66	93.3	5	0.22	3.00	0.66	ug/L	1.27	0.46	4.4
d8-Toluene	50.08	100.2	50	1.09	3.00	3.25	ug/L	6.25	2.25	2.2
1,2-Dibromoethane	4.24	84.7	5	0.21	3.00	0.63	ug/L	1.20	0.43	4.2
1,4-Dichloro-2-butene	0.73	14.6	5	0.22	3.00	0.65	ug/L	1.25	0.45	4.3
Ethyl methacrylate	2.21	44.2	5	0.29	3.00	0.88	ug/L	1.70	0.61	5.9
2-Hexanone	1.64	32.8	5	0.30	3.00	0.91	ug/L	1.75	0.63	6.1
Tetrachloroethene	4.77	95.4	5	0.35	3.00	1.04	ug/L	2.00	0.72	6.9
1,3-Dichloropropane	4.51	90.1	5	0.46	3.00	1.38	ug/L	2.65	0.95	9.2
Chlorodibromomethane	4.26	85.2	5	0.40	3.00	1.21	ug/L	2.33	0.84	8.1
1,2-Dibromoethane (EDB)	4.18	83.7	5	0.50	3.00	1.50	ug/L	2.88	1.03	10.0
Chlorobenzene	4.48	89.6	5	0.30	3.00	0.90	ug/L	1.73	0.62	6.0
Ethyl benzene	4.06	81.2	5	0.25	3.00	0.76	ug/L	1.46	0.53	5.1
m&p-Xylene	7.98	79.8	10	0.52	3.00	1.57	ug/L	3.02	1.08	5.2
o-Xylene	3.88	77.6	5	0.28	3.00	0.84	ug/L	1.62	0.58	5.6
Styrene	3.57	71.4	5	0.21	3.00	0.63	ug/L	1.21	0.43	4.2
Bromoform	3.93	78.5	5	0.42	3.00	1.27	ug/L	2.43	0.87	8.4
Isopropylbenzene (cumene)	3.79	75.8	5	0.28	3.00	0.85	ug/L	1.64	0.59	5.7
4-Bromofluorobenzene	46.02	92.0	50	1.85	3.00	5.53	ug/L	10.62	3.82	3.7
1,1,1,2-Tetrachloroethane	4.52	90.3	5	0.37	3.00	1.10	ug/L	2.12	0.76	7.4
1,1,2,2-Tetrachloroethane	5.33	106.7	5	0.81	3.00	2.43	ug/L	4.66	1.68	16.2
1,2,3-Trichloropropane	5.26	105.2	5	0.94	3.00	2.81	ug/L	5.40	1.94	18.8
n-Propylbenzene	4.42	88.5	5	0.57	3.00	1.71	ug/L	3.29	1.18	11.4
o-Chlorotoluene	5.09	101.8	5	0.79	3.00	2.36	ug/L	4.53	1.63	15.7
p-Chlorotoluene	4.71	94.1	5	0.70	3.00	2.10	ug/L	4.04	1.45	14.0
1,2,4-Trimethylbenzene	4.70	93.9	5	0.62	3.00	1.86	ug/L	3.58	1.29	12.4

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
1,2-Dichloroethane	Y	3.6	Y	Y
Benzene	Y	8.8	Y	Y
n-Heptane	Y	8.4	Y	Y
Trichloroethene	Y	7.1	Y	Y
Methyl methacrylate	Y	7.4	Y	Y
1,2-Dichloropropane	Y	7.6	Y	Y
Bromodichloromethane	Y	3.6	Y	Y
Dibromomethane	Y	1.5	Y	Y
2-Nitropropane	Y	3.3	Y	Y
2-Chloroethyl vinyl ether	Y	7.0	Y	Y
cis-1,3-Dichloropropene	Y	6.6	Y	Y
4-Methyl-2-pentanone	Y	8.6	Y	Y
Toluene	Y	11.8	N	Y
trans-1,3-Dichloropropene	Y	22.8	N	Y
1,1,2-Trichloroethane	Y	7.6	Y	Y
d8-Toluene	Y	15.4	N	Y
1,2-Dibromoethane	Y	8.0	Y	Y
1,4-Dichloro-2-butene	N	7.7	Y	Y
Ethyl methacrylate	N	5.7	Y	Y
2-Hexanone	N	5.5	Y	Y
Tetrachloroethene	Y	4.8	Y	Y
1,3-Dichloropropane	Y	3.6	Y	Y
Chlorodibromomethane	Y	4.1	Y	Y
1,2-Dibromoethane (EDB)	Y	3.3	Y	Y
Chlorobenzene	Y	5.5	Y	Y
Ethyl benzene	Y	6.6	Y	Y
m&p-Xylene	Y	6.4	Y	Y
o-Xylene	Y	5.9	Y	Y
Styrene	Y	8.0	Y	Y
Bromoform	Y	4.0	Y	Y
Isopropylbenzene (cumene)	Y	5.9	Y	Y
4-Bromofluorobenzene	Y	9.0	Y	Y
1,1,1,2-Tetrachloroethane	Y	4.5	Y	Y
1,1,2,2-Tetrachloroethane	Y	2.1	Y	Y
1,2,3-Trichloropropane	Y	1.8	Y	Y
n-Propylbenzene	Y	2.9	Y	Y
o-Chlorotoluene	Y	2.1	Y	Y
p-Chlorotoluene	Y	2.4	Y	Y
1,2,4-Trimethylbenzene	Y	2.7	Y	Y

Method Detection Limit (MDL) Study Final Report

	#1	#2	#3	#4	#5	#6	#7	#8
Compound ID:	c57732.d	c57733.d	c57734.d	c57735.d	c57736.d	c57737.d	c57738.d	C57739.D
Bromobenzene	3.46	4.99	5.09	5.25	5.32	5.14	5.20	5.09
tert-Butylbenzene	4.11	6.10	5.95	6.33	6.33	6.30	5.96	6.00
Pentachloroethane	3.23	4.83	4.70	5.44	4.88	5.16	4.82	5.18
1,3,5-Trimethylbenzene	3.13	4.64	4.65	4.76	4.60	4.66	4.65	4.63
sec-Butylbenzene	3.05	4.29	4.50	4.64	4.43	4.25	4.22	4.22
1,3-Dichlorobenzene	3.17	4.48	4.58	4.69	4.52	4.33	4.44	4.44
p-Isopropyltoluene (cymene)	2.83	3.93	3.95	3.69	3.93	3.77	3.66	3.86
1,4-Dichlorobenzene	3.51	5.04	5.05	5.23	5.00	4.94	5.00	4.80
1,2-Dichlorobenzene	3.21	4.70	4.92	4.94	4.63	4.59	4.74	4.49
n-Butylbenzene	1.41	1.81	1.53	1.71	1.57	1.42	1.52	1.25
Hexachloroethane	2.98	4.81	4.22	4.93	4.10	4.31	4.45	4.79
1,2-Dibromo-3-chloropropane	2.58	4.30	3.62	4.25	3.90	4.17	4.13	4.94
1,2,3-Trichlorobenzene	2.43	3.90	4.08	3.33	3.58	3.76	3.52	3.70
Hexachlorobutadiene	2.59	3.01	3.16	3.38	3.14	2.76	3.00	3.12
1,2,4-Trichlorobenzene	1.78	3.13	2.95	2.80	2.86	3.07	2.99	3.31
Naphthalene	1.67	3.04	2.83	2.94	2.94	3.20	2.63	2.97

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Bromobenzene	4.94	98.9	5	0.61	3.00	1.82	ug/L	3.50	1.26	12.2
tert-Butylbenzene	5.89	117.7	5	0.74	3.00	2.21	ug/L	4.23	1.52	14.7
Pentachloroethane	4.78	95.6	5	0.67	3.00	2.02	ug/L	3.87	1.39	13.4
1,3,5-Trimethylbenzene	4.47	89.3	5	0.54	3.00	1.62	ug/L	3.12	1.12	10.8
sec-Butylbenzene	4.20	84.0	5	0.49	3.00	1.46	ug/L	2.81	1.01	9.8
1,3-Dichlorobenzene	4.33	86.6	5	0.48	3.00	1.44	ug/L	2.77	1.00	9.6
p-Isopropyltoluene (cymene)	3.70	74.1	5	0.37	3.00	1.11	ug/L	2.13	0.77	7.4
1,4-Dichlorobenzene	4.82	96.4	5	0.54	3.00	1.63	ug/L	3.13	1.12	10.9
1,2-Dichlorobenzene	4.53	90.6	5	0.55	3.00	1.66	ug/L	3.19	1.15	11.1
n-Butylbenzene	1.53	30.6	5	0.18	3.00	0.53	ug/L	1.01	0.36	3.5
Hexachloroethane	4.32	86.5	5	0.62	3.00	1.86	ug/L	3.58	1.29	12.4
1,2-Dibromo-3-chloropropane	3.99	79.7	5	0.68	3.00	2.04	ug/L	3.92	1.41	13.6
1,2,3-Trichlorobenzene	3.54	70.8	5	0.50	3.00	1.51	ug/L	2.90	1.04	10.1
Hexachlorobutadiene	3.02	60.4	5	0.25	3.00	0.74	ug/L	1.42	0.51	4.9
1,2,4-Trichlorobenzene	2.86	57.2	5	0.47	3.00	1.39	ug/L	2.68	0.96	9.3
Naphthalene	2.78	55.6	5	0.48	3.00	1.43	ug/L	2.74	0.99	9.5

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times	MDL Spk Conc
Bromobenzene	Y	2.7	Y	Y
tert-Butylbenzene	Y	2.3	Y	Y
Pentachloroethane	Y	2.5	Y	Y
1,3,5-Trimethylbenzene	Y	3.1	Y	Y
sec-Butylbenzene	Y	3.4	Y	Y
1,3-Dichlorobenzene	Y	3.5	Y	Y
p-Isopropyltoluene (cymene)	Y	4.5	Y	Y
1,4-Dichlorobenzene	Y	3.1	Y	Y
1,2-Dichlorobenzene	Y	3.0	Y	Y
n-Butylbenzene	N	9.5	Y	Y
Hexachloroethane	Y	2.7	Y	Y
1,2-Dibromo-3-chloropropane	Y	2.4	Y	Y
1,2,3-Trichlorobenzene	Y	3.3	Y	Y
Hexachlorobutadiene	Y	6.8	Y	Y
1,2,4-Trichlorobenzene	Y	3.6	Y	Y
Naphthalene	Y	3.5	Y	Y

Outliers: 7 3 3

Method Detection Limit (MDL) Study Final Report

Laboratory:	First Environmental Laboratories, Inc.		
Method / Revision (all):	SW-846 Method 8260B/EPA 600/482-057 Method 624		
Analyte or Analyte Group:	Volatiles - Aqueous		
Preparation Analyst:	Not Applicable		
Instrument Analyst:	Pam Hentschel		
Date of Analysis:	3/28/02		
Instrument ID:	GC/MS "C" with Archon Autosampler		
Instrument Conditions:	Standard		
Est. Detection Limit:	5.0 ug/L		

Calib. Standards Source:	Supelco #5377, #5378	Date Prepared:	2/22/02
Spiking Solution Source:	Supelco #5418, #5419	Date Prepared:	3/13/02
Spiking Concentration:	2.0 ug/L	Units:	ug/L

A minimum of seven replicates was used to perform the MDL study? ☒_yes ☐_no
 Were all replicates values used in determining the MDL? ☒_yes ☐_no

If no, submit documentation verifying that the laboratory excluded values which it determined are outliers by using a statistical outlier test.

Has the laboratory established criteria for accepting replicate percent recovery? ☒_yes ☐_no

If yes, the acceptance criteria can be found in MDL SOP page 6. (\pm 50% or per method)

If yes, this MDL study has met the laboratory's criteria for acceptable replicate percent recovery? ☐_yes ☒_no

The calculated MDL is greater than "0"? ☒_yes ☐_no

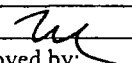
The calculated MDL is greater than 1/10 the MDL spiking concentration? ☒_yes ☐_no

The MDL spiking concentration is greater than the calculated MDL? ☒_yes ☐_no

For drinking water laboratory accreditation, the laboratory has achieved a MDL equal to or less than those specified in Section 186 Appendix A? 186.160(c) ☐_yes ☐_no

Only MDL studies meeting the requirements set forth in Section 186.160 will be deemed acceptable.

Comments: SPIKED BELOW THE ROUTINE RL at 2.0 ug/L.
19 outliers; Spike recovery.
MDL also PERFORMED AT 5.0 ug/L.

Approved by: 

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8
	c57740.d	c57741.d	c57742.d	c57743.d	c57744.d	c57745.d	c57746.d	c57747.d
Dichlorodifluoromethane	1.64	1.73	1.80	1.72	1.81	1.97	2.02	1.98
Chloromethane	1.92	1.99	1.68	1.70	1.99	1.95	1.75	2.12
Vinyl Chloride	1.84	1.94	1.95	1.86	1.85	2.07	2.06	2.14
Bromomethane	3.19	2.53	2.80	2.87	2.89	3.52	3.12	2.45
Chloroethane	1.58	1.93	2.09	2.07	2.34	2.24	2.48	2.10
Trichlorofluoromethane	1.82	1.95	2.01	1.90	2.04	2.27	2.17	2.20
Ethyl ether	2.24	2.06	2.01	2.13	2.40	2.05	2.37	2.19
Acrolein	20.82	21.81	17.20	16.42	15.72	15.43	22.16	23.05
Acetone	3.40	2.10	2.76	2.99	3.11	2.37	3.75	4.09
1,1-Dichloroethene	1.89	1.90	1.76	1.95	1.89	2.07	1.76	1.86
Iodomethane	1.63	1.59	1.28	1.40	1.31	1.51	1.31	1.37
Allyl chloride	0.33	0.64	0.52	0.85	0.66	0.75	1.28	0.43
Methylene chloride	2.09	2.27	2.28	2.33	2.28	2.13	2.62	2.38
Acrylonitrile	10.03	9.20	9.07	9.34	10.07	9.82	10.01	11.29
Carbon disulfide	1.51	1.75	1.60	1.58	1.70	1.74	1.76	1.79
trans-1,2-Dichloroethene	1.88	1.82	1.73	1.73	2.10	1.93	1.96	1.97
cis-1,2-Dichloroethene	1.87	1.79	1.86	1.80	1.92	2.01	1.80	2.07
Methyl-t-butyl ether (MTBE)	1.66	1.66	1.90	1.79	1.79	1.94	2.09	1.82
n-Hexane	1.79	1.77	1.69	1.59	1.64	1.66	2.00	1.99
Vinyl Acetate	1.09	1.05	0.76	0.84	0.47	0.93	0.81	0.44
1,1-Dichloroethane	1.89	1.94	1.94	1.96	2.06	1.99	2.17	2.03
2,2-Dichloropropane	0.00	0.05	0.31	0.05	0.11	0.52	2.51	0.00
2-Butanone (MEK)	0.00	0.00	0.00	0.00	0.40	0.77	0.71	0.00
Propionitrile	0.00	0.26	0.00	0.00	0.67	0.42	0.00	0.00
Methyl acrylate	0.90	0.82	0.00	0.81	0.62	0.74	0.73	1.10
Bromochloromethane	1.82	1.77	1.89	1.96	1.97	2.03	2.10	1.95
Methacrylonitrile	1.73	2.03	1.84	2.16	1.78	1.87	2.02	2.17
Tetrahydrofuran (THF)	2.40	2.19	1.85	1.56	2.45	2.47	2.04	2.16
Chloroform	3.21	3.23	3.02	3.12	3.13	3.22	3.28	3.49
Dibromofluoromethane	50.21	50.12	50.44	51.11	50.65	52.54	54.04	52.34
1,1,1-Trichloroethane	1.39	1.55	1.85	1.61	1.56	2.09	2.28	1.85
Butyl chloride (1-chlorobutane)	2.68	2.77	2.59	2.69	2.64	2.72	2.58	2.94
Carbon tetrachloride	1.21	1.63	2.19	1.91	1.67	2.58	2.53	2.04
1,1-Dichloropropene	1.96	1.87	1.71	1.76	2.10	1.96	2.07	2.18

Method Detection Limit (MDL) Study Final Report

Note: CL = confidence limit

Check T value @ 99% Confidence Level for No. of replicates in study

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Dichlorodifluoromethane	1.83	91.7	2	0.14	3.00	0.42	ug/L	0.81	0.29	7.0
Chloromethane	1.89	94.4	2	0.16	3.00	0.48	ug/L	0.92	0.33	8.0
Vinyl Chloride	1.96	98.2	2	0.11	3.00	0.34	ug/L	0.66	0.24	5.7
Bromomethane <i>ol</i>	2.92	146.1	2	0.35	3.00	1.05	ug/L	2.02	0.73	17.6
Chloroethane	2.10	105.2	2	0.27	3.00	0.82	ug/L	1.57	0.56	13.7
Trichlorofluoromethane	2.05	102.3	2	0.16	3.00	0.47	ug/L	0.90	0.32	7.8
Ethyl ether	2.18	109.1	2	0.15	3.00	0.44	ug/L	0.85	0.30	7.3
Acrolein	19.08	190.8	10	3.18	3.00	9.54	ug/L	18.33	6.59	31.8
Acetone	3.07	153.6 •	2	0.67	3.00	2.01	ug/L	3.86	1.39	33.5
1,1-Dichloroethene	1.89	94.3	2	0.10	3.00	0.30	ug/L	0.58	0.21	5.0
Iodomethane	1.43	71.3	2	0.14	3.00	0.40	ug/L	0.78	0.28	6.8
Allyl chloride	0.68	34.1 •	2	0.29	3.00	0.88	ug/L	1.69	0.61	14.7
Methylene chloride	2.30	114.9	2	0.16	3.00	0.49	ug/L	0.93	0.34	8.1
Acrylonitrile	9.85	98.5	10	0.70	3.00	2.11	ug/L	4.05	1.46	7.0
Carbon disulfide	1.68	83.9	2	0.10	3.00	0.31	ug/L	0.59	0.21	5.1
trans-1,2-Dichloroethene	1.89	94.5	2	0.13	3.00	0.38	ug/L	0.73	0.26	6.4
cis-1,2-Dichloroethene	1.89	94.5	2	0.10	3.00	0.31	ug/L	0.60	0.21	5.2
Methyl-t-butyl ether (MTBE)	1.83	91.6	2	0.14	3.00	0.43	ug/L	0.83	0.30	7.2
n-Hexane	1.77	88.3	2	0.16	3.00	0.47	ug/L	0.90	0.32	7.8
Vinyl Acetate	0.80	39.9 •	2	0.24	3.00	0.72	ug/L	1.39	0.50	12.0
1,1-Dichloroethane	2.00	99.9	2	0.09	3.00	0.26	ug/L	0.51	0.18	4.4
2,2-Dichloropropane	0.44	22.2 •	2	0.85	3.00	2.56	ug/L	4.92	1.77	42.7
2-Butanone (MEK)	0.24	11.8 •	2	0.34	3.00	1.02	ug/L	1.96	0.71	17.1
Propionitrile	0.17	8.4 •	2	0.26	3.00	0.77	ug/L	1.48	0.53	12.9
Methyl acrylate	0.72	35.8 •	2	0.32	3.00	0.96	ug/L	1.85	0.67	16.1
Bromochloromethane	1.94	96.8	2	0.11	3.00	0.32	ug/L	0.62	0.22	5.4
Methacrylonitrile	1.95	97.5	2	0.17	3.00	0.51	ug/L	0.97	0.35	8.4
Tetrahydrofuran (THF)	2.14	107.0	2	0.32	3.00	0.95	ug/L	1.83	0.66	15.9
Chloroform	3.21	160.6 •	2	0.14	3.00	0.42	ug/L	0.80	0.29	6.9
Dibromofluoromethane	51.43	102.9	50	1.40	3.00	4.20	ug/L	8.07	2.90	2.8
1,1,1-Trichloroethane	1.77	88.6	2	0.30	3.00	0.90	ug/L	1.74	0.62	15.1
Butyl chloride (1-chlorobutane)	2.70	135.1	2	0.12	3.00	0.35	ug/L	0.67	0.24	5.8
Carbon tetrachloride	1.97	98.5	2	0.47	3.00	1.40	ug/L	2.69	0.97	23.3
1,1-Dichloropropene	1.95	97.6	2	0.16	3.00	0.49	ug/L	0.95	0.34	8.2

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times MDL	MDL Spk Conc is >MDL
Dichlorodifluoromethane	Y	4.8	Y	Y
Chloromethane	Y	4.2	Y	Y
Vinyl Chloride	Y	5.8	Y	Y
Bromomethane	Y	1.9	Y	Y
Chloroethane	Y	2.4	Y	Y
Trichlorofluoromethane	Y	4.3	Y	Y
Ethyl ether	Y	4.5	Y	Y
Acrolein	N	1.0	Y	Y
Acetone	N	1.0	Y	N
1,1-Dichloroethene	Y	6.6	Y	Y
Iodomethane	Y	4.9	Y	Y
Allyl chloride	N	2.3	Y	Y
Methylene chloride	Y	4.1	Y	Y
Acrylonitrile	Y	4.7	Y	Y
Carbon disulfide	Y	6.5	Y	Y
trans-1,2-Dichloroethene	Y	5.2	Y	Y
cis-1,2-Dichloroethene	Y	6.4	Y	Y
Methyl-t-butyl ether (MTBE)	Y	4.6	Y	Y
n-Hexane	Y	4.3	Y	Y
Vinyl Acetate	N	2.8	Y	Y
1,1-Dichloroethane	Y	7.6	Y	Y
2,2-Dichloropropane	N	0.8	Y	N
2-Butanone (MEK)	N	2.0	Y	Y
Propionitrile	N	2.6	Y	Y
Methyl acrylate	N	2.1	Y	Y
Bromochloromethane	Y	6.2	Y	Y
Methacrylonitrile	Y	4.0	Y	Y
Tetrahydrofuran (THF)	Y	2.1	Y	Y
Chloroform	N	4.8	Y	Y
Dibromofluoromethane	Y	11.9	N	Y
1,1,1-Trichloroethane	Y	2.2	Y	Y
Butyl chloride (1-chlorobutane)	Y	5.8	Y	Y
Carbon tetrachloride	Y	1.4	Y	Y
1,1-Dichloropropene	Y	4.0	Y	Y

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8
	c57740.d	c57741.d	c57742.d	c57743.d	c57744.d	c57745.d	c57746.d	c57747.d
1,2-Dichloroethane	1.90	1.85	2.00	1.91	2.22	1.93	2.00	2.36
Benzene	1.89	1.88	1.94	1.87	1.89	1.87	1.97	2.14
n-Heptane	1.46	1.33	1.53	1.26	1.49	1.29	1.20	1.35
Trichloroethene	1.97	1.97	1.81	1.92	2.07	2.03	2.11	2.19
Methyl methacrylate	0.71	0.62	0.74	0.80	0.79	0.96	0.82	0.80
1,2-Dichloropropane	1.58	1.90	1.84	2.02	1.94	1.90	1.83	2.02
Bromodichloromethane	1.41	1.47	2.10	1.67	1.61	1.87	2.09	1.92
Dibromomethane	1.93	2.24	2.17	2.05	2.53	2.50	2.53	2.49
2-Nitropropane	0.68	1.94	1.89	1.86	0.79	1.74	0.64	1.55
2-Chloroethyl vinyl ether	0.62	0.63	0.76	0.51	0.66	0.93	0.76	0.53
cis-1,3-Dichloropropene	1.29	1.40	1.45	1.37	1.46	1.35	1.23	1.44
4-Methyl-2-pentanone	1.69	1.72	2.03	2.01	2.09	1.63	1.76	1.66
Toluene	1.82	1.92	1.80	1.86	1.80	1.78	1.79	2.00
trans-1,3-Dichloropropene	0.93	0.85	0.82	0.87	0.94	0.89	0.80	1.00
1,1,2-Trichloroethane	2.00	2.03	1.82	1.95	1.85	1.96	1.89	2.03
d8-Toluene	49.19	49.02	47.53	49.83	49.39	46.14	48.95	49.42
1,2-Dibromoethane	1.42	1.47	1.55	1.45	1.55	1.51	1.35	1.48
1,4-Dichloro-2-butene	0.28	0.38	0.26	0.41	0.43	0.34	0.36	0.27
Ethyl methacrylate	0.73	0.81	0.77	0.86	0.73	0.86	0.74	0.81
2-Hexanone	0.16	0.42	0.24	0.36	0.36	0.39	0.57	0.22
Tetrachloroethene	3.21	3.38	3.18	3.34	3.51	3.35	3.57	3.89
1,3-Dichloropropane	1.73	1.68	1.84	1.87	1.94	1.85	1.82	1.91
Chlorodibromomethane	1.65	1.71	1.64	1.79	1.70	1.67	1.77	1.84
1,2-Dibromoethane (EDB)	1.44	1.53	1.57	1.47	1.60	1.58	1.43	1.54
Chlorobenzene	1.83	1.99	1.77	1.85	1.84	1.90	1.83	2.02
Ethyl benzene	1.50	1.65	1.55	1.57	1.64	1.64	1.62	1.66
m&p-Xylene	2.98	3.29	3.08	2.71	3.11	3.05	3.00	3.33
o-Xylene	1.43	1.49	1.35	1.34	1.56	1.44	1.44	1.53
Styrene	1.15	1.26	1.24	1.24	1.28	1.25	1.26	1.33
Bromoform	1.43	1.63	1.33	1.32	1.62	1.54	1.65	1.65
Isopropylbenzene (cumene)	1.36	1.45	1.31	1.32	1.37	1.39	1.34	1.51
4-Bromofluorobenzene	45.23	43.17	41.78	44.03	45.30	43.63	43.80	45.28
1,1,1,2-Tetrachloroethane	1.75	1.97	1.64	1.86	1.96	1.79	1.97	2.02
1,1,2,2-Tetrachloroethane	2.26	2.32	2.49	2.38	2.38	2.26	2.32	2.33
1,2,3-Trichloropropane	2.54	2.16	2.59	2.29	2.11	2.15	2.25	2.14
n-Propylbenzene	1.65	1.75	1.93	1.70	1.88	1.74	1.72	1.99
o-Chlorotoluene	2.13	2.41	2.56	2.25	2.57	2.50	2.24	2.62
p-Chlorotoluene	1.83	1.97	2.28	1.94	2.11	2.11	2.03	2.26
1,2,4-Trimethylbenzene	1.93	2.01	2.13	1.85	1.98	1.99	1.94	2.13

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
1,2-Dichloroethane	2.02	101.1	2	0.18	3.00	0.53	ug/L	1.02	0.37	8.9
Benzene	1.93	96.6	2	0.09	3.00	0.27	ug/L	0.53	0.19	4.6
n-Heptane	1.36	68.2	2	0.12	3.00	0.35	ug/L	0.68	0.24	5.9
Trichloroethene	2.01	100.4	2	0.12	3.00	0.35	ug/L	0.68	0.24	5.9
Methyl methacrylate	0.78	39.0	2	0.10	3.00	0.29	ug/L	0.56	0.20	4.9
1,2-Dichloropropane	1.88	93.9	2	0.14	3.00	0.42	ug/L	0.81	0.29	7.0
Bromodichloromethane	1.77	88.4	2	0.27	3.00	0.80	ug/L	1.54	0.55	13.3
Dibromomethane	2.31	115.3	2	0.24	3.00	0.72	ug/L	1.38	0.50	12.0
2-Nitropropane	1.39	69.3	2	0.58	3.00	1.74	ug/L	3.33	1.20	29.0
2-Chloroethyl vinyl ether	0.68	33.8	2	0.14	3.00	0.41	ug/L	0.79	0.29	6.9
cis-1,3-Dichloropropene	1.37	68.7	2	0.08	3.00	0.24	ug/L	0.47	0.17	4.1
4-Methyl-2-pentanone	1.82	91.2	2	0.19	3.00	0.56	ug/L	1.08	0.39	9.4
Toluene	1.85	92.3	2	0.08	3.00	0.23	ug/L	0.44	0.16	3.9
trans-1,3-Dichloropropene	0.89	44.4	2	0.07	3.00	0.20	ug/L	0.38	0.14	3.3
1,1,2-Trichloroethane	1.94	97.1	2	0.08	3.00	0.24	ug/L	0.46	0.17	4.0
d8-Toluene	48.68	97.4	50	1.23	3.00	3.69	ug/L	7.08	2.55	2.5
1,2-Dibromoethane	1.47	73.6	2	0.07	3.00	0.20	ug/L	0.39	0.14	3.4
1,4-Dichloro-2-butene	0.34	17.1	2	0.07	3.00	0.20	ug/L	0.38	0.14	3.3
Ethyl methacrylate	0.79	39.4	2	0.05	3.00	0.16	ug/L	0.31	0.11	2.7
2-Hexanone	0.34	17.0	2	0.13	3.00	0.39	ug/L	0.75	0.27	6.5
Tetrachloroethene	3.43	171.4	2	0.23	3.00	0.69	ug/L	1.32	0.47	11.4
1,3-Dichloropropane	1.83	91.5	2	0.09	3.00	0.26	ug/L	0.50	0.18	4.4
Chlorodibromomethane	1.72	86.1	2	0.07	3.00	0.22	ug/L	0.41	0.15	3.6
1,2-Dibromoethane (EDB)	1.52	76.0	2	0.07	3.00	0.20	ug/L	0.38	0.14	3.3
Chlorobenzene	1.88	93.9	2	0.09	3.00	0.26	ug/L	0.49	0.18	4.3
Ethyl benzene	1.60	80.2	2	0.06	3.00	0.17	ug/L	0.33	0.12	2.9
m&p-Xylene	3.07	76.7	4	0.19	3.00	0.58	ug/L	1.11	0.40	4.8
o-Xylene	1.45	72.4	2	0.08	3.00	0.23	ug/L	0.45	0.16	3.9
Styrene	1.25	62.6	2	0.05	3.00	0.15	ug/L	0.29	0.10	2.5
Bromoform	1.52	76.1	2	0.14	3.00	0.42	ug/L	0.82	0.29	7.1
Isopropylbenzene (cumene)	1.38	69.1	2	0.07	3.00	0.20	ug/L	0.39	0.14	3.4
4-Bromofluorobenzene	44.03	88.1	50	1.23	3.00	3.69	ug/L	7.09	2.55	2.5
1,1,1,2-Tetrachloroethane	1.87	93.5	2	0.13	3.00	0.40	ug/L	0.77	0.28	6.7
1,1,2,2-Tetrachloroethane	2.34	117.1	2	0.07	3.00	0.22	ug/L	0.43	0.16	3.7
1,2,3-Trichloropropane	2.28	113.9	2	0.19	3.00	0.56	ug/L	1.08	0.39	9.3
n-Propylbenzene	1.80	89.8	2	0.12	3.00	0.37	ug/L	0.70	0.25	6.1
o-Chlorotoluene	2.41	120.5	2	0.18	3.00	0.55	ug/L	1.05	0.38	9.1
p-Chlorotoluene	2.07	103.3	2	0.16	3.00	0.47	ug/L	0.90	0.32	7.8
1,2,4-Trimethylbenzene	2.00	99.8	2	0.10	3.00	0.29	ug/L	0.56	0.20	4.8

Method Detection Limit (MDL) Study Final Report

Compound ID:	%R is <50 - 150	Spk/MDL	Spk Conc <10 times Spk Conc	MDL
1,2-Dichloroethane	Y	3.8	Y	Y
Benzene	Y	7.3	Y	Y
n-Heptane	Y	5.7	Y	Y
Trichloroethene	Y	5.6	Y	Y
Methyl methacrylate	N	6.8	Y	Y
1,2-Dichloropropane	Y	4.8	Y	Y
Bromodichloromethane	Y	2.5	Y	Y
Dibromomethane	Y	2.8	Y	Y
2-Nitropropane	Y	1.2	Y	Y
2-Chloroethyl vinyl ether	N	4.8	Y	Y
cis-1,3-Dichloropropene	Y	8.2	Y	Y
4-Methyl-2-pentanone	Y	3.6	Y	Y
Toluene	Y	8.6	Y	Y
trans-1,3-Dichloropropene	N	10.0	N	Y
1,1,2-Trichloroethane	Y	8.3	Y	Y
d8-Toluene	Y	13.6	N	Y
1,2-Dibromoethane	Y	9.9	Y	Y
1,4-Dichloro-2-butene	N	10.2	N	Y
Ethyl methacrylate	N	12.3	N	Y
2-Hexanone	N	5.1	Y	Y
Tetrachloroethene	N	2.9	Y	Y
1,3-Dichloropropane	Y	7.7	Y	Y
Chlorodibromomethane	Y	9.3	Y	Y
1,2-Dibromoethane (EDB)	Y	10.2	N	Y
Chlorobenzene	Y	7.8	Y	Y
Ethyl benzene	Y	11.6	N	Y
m&p-Xylene	Y	6.9	Y	Y
o-Xylene	Y	8.5	Y	Y
Styrene	Y	13.3	N	Y
Bromoform	Y	4.7	Y	Y
Isopropylbenzene (cumene)	Y	9.8	Y	Y
4-Bromofluorobenzene	Y	13.5	N	Y
1,1,1,2-Tetrachloroethane	Y	5.0	Y	Y
1,1,2,2-Tetrachloroethane	Y	8.9	Y	Y
1,2,3-Trichloropropane	Y	3.6	Y	Y
n-Propylbenzene	Y	5.5	Y	Y
o-Chlorotoluene	Y	3.7	Y	Y
p-Chlorotoluene	Y	4.3	Y	Y
1,2,4-Trimethylbenzene	Y	6.9	Y	Y

Method Detection Limit (MDL) Study Final Report

Compound ID:	#1	#2	#3	#4	#5	#6	#7	#8
	c57740.d	c57741.d	c57742.d	c57743.d	c57744.d	c57745.d	c57746.d	c57747.d
Bromobenzene	2.08	2.23	2.45	2.13	2.49	2.21	2.19	2.59
tert-Butylbenzene	1.70	1.86	2.13	2.03	1.95	1.71	1.89	2.08
Pentachloroethane	0.00	0.00	0.06	0.10	0.05	0.00	0.00	0.00
1,3,5-Trimethylbenzene	1.58	1.65	1.82	1.68	1.77	1.85	1.69	1.97
sec-Butylbenzene	1.47	1.47	1.71	1.28	1.56	1.62	1.57	1.68
1,3-Dichlorobenzene	1.79	1.56	1.64	1.40	1.66	1.86	1.61	1.69
p-Isopropyltoluene (cymene)	1.10	0.95	1.09	0.90	0.83	0.92	1.06	1.01
1,4-Dichlorobenzene	1.98	2.06	2.17	1.97	1.97	2.05	2.13	2.13
1,2-Dichlorobenzene	1.77	1.79	2.16	1.78	1.85	1.79	1.82	2.02
n-Butylbenzene	0.40	0.49	0.54	0.39	0.45	0.48	0.47	0.56
Hexachloroethane	1.81	1.92	2.06	1.63	1.96	1.75	2.17	1.94
1,2-Dibromo-3-chloropropane	0.70	2.92	1.21	0.71	0.48	2.14	0.84	1.61
1,2,3-Trichlorobenzene	1.50	1.54	1.33	0.87	1.55	1.16	1.15	1.23
Hexachlorobutadiene	1.40	1.13	1.81	1.43	1.22	1.41	1.72	1.53
1,2,4-Trichlorobenzene	1.99	1.44	1.28	1.16	1.34	1.26	0.84	1.37
Naphthalene	1.42	1.26	1.10	0.91	1.02	1.03	1.02	0.94

Method Detection Limit (MDL) Study Final Report

Compound ID:	Mean Conc	Mean % rec	Spk Amt	Std Dev	T Value	MDL	Units	Upper CL	Lower CL	RSD %
Bromobenzene	2.30	114.8	2	0.19	3.00	0.56	ug/L	1.08	0.39	9.4
tert-Butylbenzene	1.92	95.9	2	0.16	3.00	0.48	ug/L	0.92	0.33	8.0
Pentachloroethane	0.03	1.3	2	0.04	3.00	0.12	ug/L	0.22	0.08	1.9
1,3,5-Trimethylbenzene	1.75	87.6	2	0.13	3.00	0.38	ug/L	0.73	0.26	6.3
sec-Butylbenzene	1.55	77.3	2	0.14	3.00	0.41	ug/L	0.79	0.29	6.9
1,3-Dichlorobenzene	1.65	82.6	2	0.14	3.00	0.42	ug/L	0.81	0.29	7.0
p-Isopropyltoluene (cymene)	0.98	49.1	2	0.10	3.00	0.29	ug/L	0.56	0.20	4.9
1,4-Dichlorobenzene	2.06	102.9	2	0.08	3.00	0.24	ug/L	0.46	0.17	4.0
1,2-Dichlorobenzene	1.87	93.6	2	0.14	3.00	0.42	ug/L	0.82	0.29	7.1
n-Butylbenzene	0.47	23.6	2	0.06	3.00	0.18	ug/L	0.35	0.12	3.0
Hexachloroethane	1.91	95.3	2	0.17	3.00	0.52	ug/L	0.99	0.36	8.6
1,2-Dibromo-3-chloropropane	1.33	66.3	2	0.85	3.00	2.54	ug/L	4.87	1.75	42.3
1,2,3-Trichlorobenzene	1.29	64.6	2	0.24	3.00	0.71	ug/L	1.36	0.49	11.8
Hexachlorobutadiene	1.46	72.8	2	0.23	3.00	0.69	ug/L	1.32	0.47	11.5
1,2,4-Trichlorobenzene	1.34	66.8	2	0.32	3.00	0.97	ug/L	1.85	0.67	16.1
Naphthalene	1.09	54.4	2	0.17	3.00	0.51	ug/L	0.99	0.35	8.6

Lockformer Work Plan QAPP
Date: 2/28/2003
65263.01- Rev.3

ATTACHMENT C

FIRST ENVIRONMENTAL LABORATORIES QUALITY ASSURANCE DATA PACKAGE

The Analytical Report will consist of the following:

- Chain of Custody (COC) documentation
- Sample Results
- Reporting Limits
- Method Citations
- Note: a "J" flag will be used to indicate positive results above the Method Detection Limit (MDL), but below the established Reporting Limit (RL).
- Results for soil samples will be reported on a dry weight basis.

A QC Package will be provided and it will consist of the following:

- Case Narrative
- Surrogate recoveries
- Method Blank Association Form
- Method Blank results
- Laboratory Control Spike results
- Batch or client specific Matrix Spike/Matrix Spike Duplicate (MS/MSD) results. If MS/MSD data represents batch QC, a notation will be included in the case narrative.